

Electrical Contracting

JANUARY
1945

The Magazine of

ELECTRICAL CONSTRUCTION AND MAINTENANCE



IN THIS ISSUE . . . Appraising '45 markets and opportunities . . . Wiring ideas from the LCT . . . The annual wage, is it politics or sound social engineering . . . Labor only contracts have management costs, usually

ignored — but expensive to forget . . . First of a series on lighting applications . . . Labor data on installing branch circuit wiring . . . High cycle wiring . . . And many practical methods for the shop and job.

SEE HOW THIS COMPANY BROUGHT THE RIGHT VOLTAGE TO THE JOB SHOWS VERSATILITY OF SMALL G-E DRY-TYPE TRANSFORMERS



The unique sling-mounted power supply shown above was fabricated by the Permanente Metals Corporation, Richmond, Calif., Shipyard No. 2. As many as three of these units are placed at strategic points on the upper deck of a ship abuilding to provide a convenient source of power for portable blowers, tools, and lighting. They operate from a nominal 480-volt, three-phase supply.

Each unit consists of three G-E single-phase, 25-kva, dry-type transformers which form a three-phase bank, connected delta primary and wye secondary. This hook-up steps down the 480-volt supply to 208 volts three-phase, or 120 volts, line-to-neutral, single-phase—a time-saving application of in-stock, standard

transformers to perform a special job.

These transformers (Type D) are of the same construction being used, profitably, from coast-to-coast on secondary circuits in industrial plants. They provide the right voltage for the most economical operation of a wide variety of electric equipment. As they don't require fireproof vaults, they can be installed right next to the load, thus avoiding long runs of expensive copper. Their small size, light weight, and compactness make them easy to install on the floor, on the wall—anywhere you wish.

They are available in ratings up to and including 100 kva, 600 volts and below. For further information, ask for Bulletin GEA-897. *General Electric Company, Schenectady 5, N. Y.*

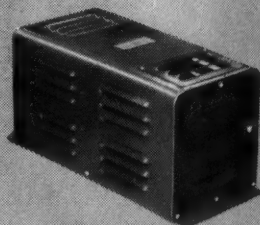
A FEW OF THE MANY PURPOSES FOR WHICH YOU CAN USE TYPE D TRANSFORMERS TO ADVANTAGE:

- To insulate lighting circuits from power circuits
- To boost low line voltage to improve equipment performance
- To reduce light flicker caused by motor starting, etc.
- To supply correct voltage for the most efficient operation of motors, machine tools, welding apparatus, etc.

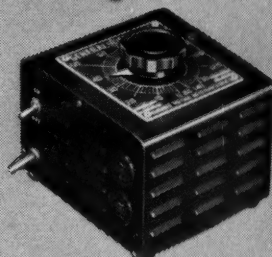
GENERAL  ELECTRIC

409-76-0205, 5400

OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.



AIR-COOLED REGULATORS—Automatic type: for secondary circuits (10% regulation, raise and lower). Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts.

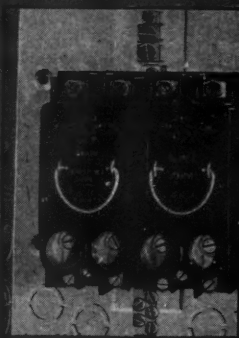
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DOES THE JOB

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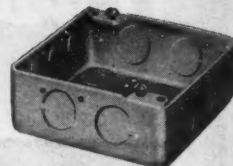
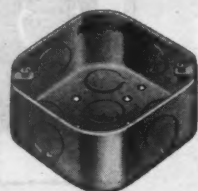
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ELECTRICAL CONTRACTING. Published monthly, price 25 cents a copy. Vol. 44, No. 1. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication Office, 99-129 N. Broadway, Albany, N. Y. All communications about subscriptions should be addressed to the Director of Circulation, Electrical Contracting, 330 West 42nd St., New York 18, N. Y. Subscription Rates—U. S. A. and Latin American Republics, \$2.00 a year, \$3.00 for two years, \$4.00 for three years; Canada \$1.50 a year, \$4.00 for two years, \$5.00 for three years. Great Britain and British Possessions, 18 shillings for one year, 36 shillings for three years. All other countries \$5.00 a year, \$6.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter August 29, 1926, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. Copyright 1945 by McGraw-Hill Publishing Company, Cable address: "McGraw-Hill, New York." Member A. B. P. Member A. B. C.

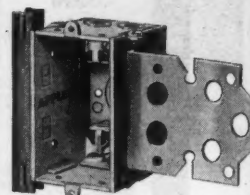
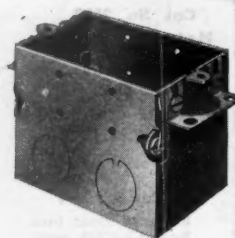
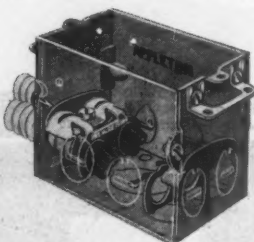
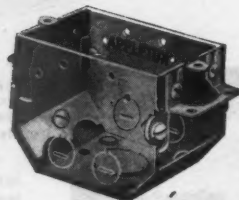
OUTLETS—SWITCH BOXES—CONDUIT FITTINGS *For Every Preference and Specification*

For Example



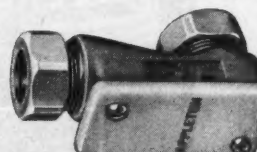
3/4 AND 4 INCH OCTAGONAL BOXES—4 AND 4 1/16 INCH SQUARE BOXES—WIDE SELECTION OF COVERS

For Example



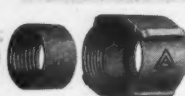
SWITCH BOXES, VARIOUS DEPTHS, WITH OR WITHOUT CLAMPS AND BRACKETS

For Example



COUPLINGS AND CONNECTORS, ENTRANCE FITTINGS, CLAMPS, ETC. FOR ELECTRICAL METALLIC TUBING

For Example



COUPLINGS, CONNECTORS, CLAMPS AND ENTRANCE FITTINGS FOR RIGID CONDUIT.

STRAIGHT AND ANGLE CONNECTORS FOR ARMORED CABLE, FLEXIBLE CONDUIT, ETC.



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The products illustrated above are examples—products from Appleton's own foundries and fabricating plants, designed by Appleton engineers, and recognized throughout the electrical industry as "STANDARD FOR BETTER WIRING."

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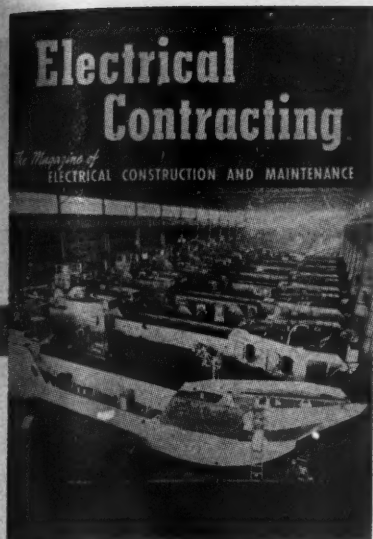
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OUR COVER—Production line wiring of the LCT. Story on page 48.

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

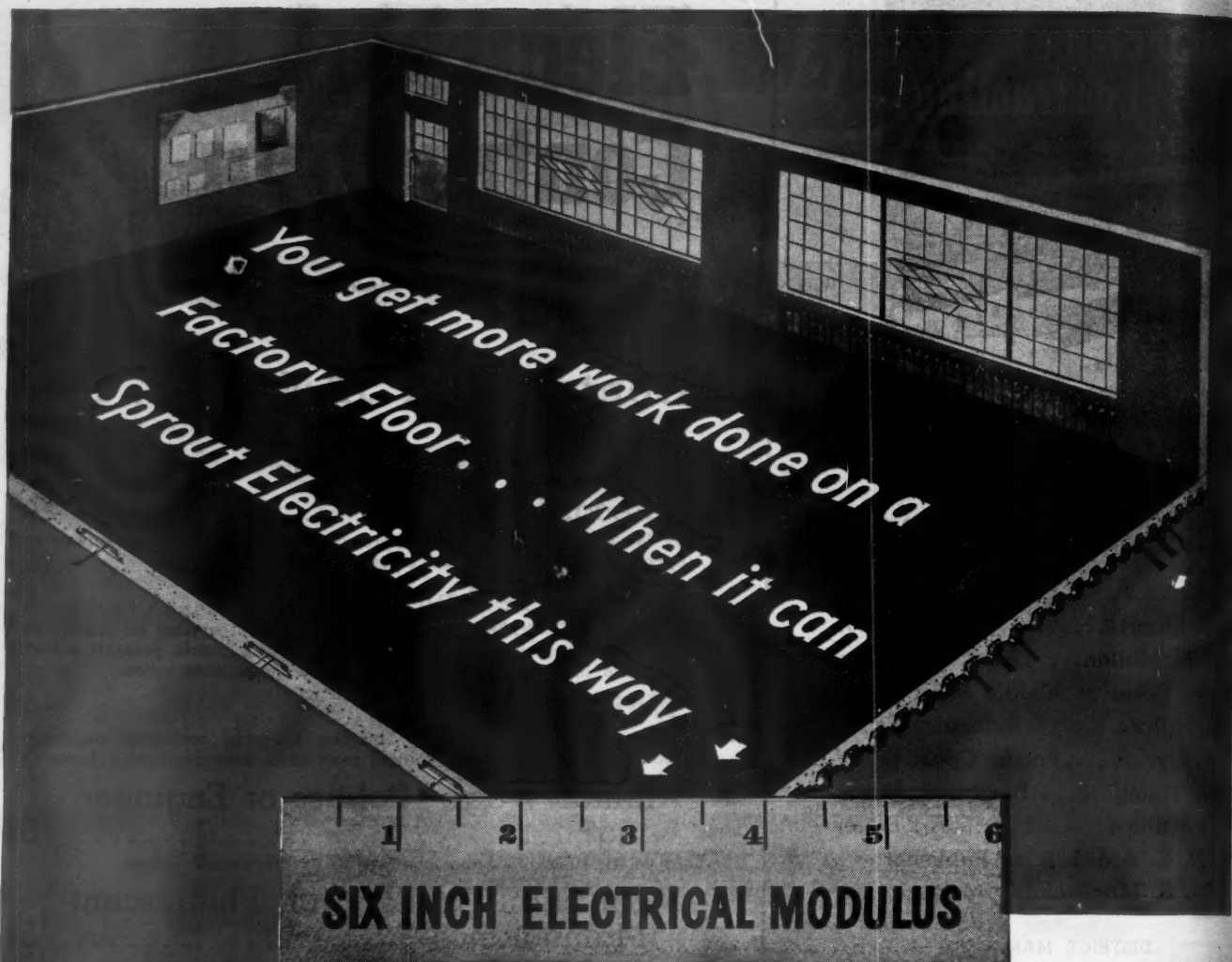
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Electrical Fittings for use with Robertson Q-Floors can be obtained from General Electric Construction materials distributors. See the nearest G.E. Merchandise Distributor for information on how these fittings can be used to attain up-to-the-minute electrical wiring.

Q-FLOORS

When a floor can be tapped on any six-inch area and have an electrical outlet installed, it encourages the greater use of electricity.

Robertson Q-Floors are constructed on this six-inch electrical modulus.

Steel cells, six inches apart, are connected by cross-over raceways. This construction promotes the use of electrical equipment. More important to the electrical trade, the quick-change possible with Robertson Q-Floors gets owners into the habit of calling an electrician to change the location of electrical outlets to meet changing needs.

The emphasis of a Robertson Q-Floor is on better electrical service—and more of it.

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NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test... wait 5, 10, 15 years and see.

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: "*You can depend on Allis-Chalmers Motors!*"

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YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend*... and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

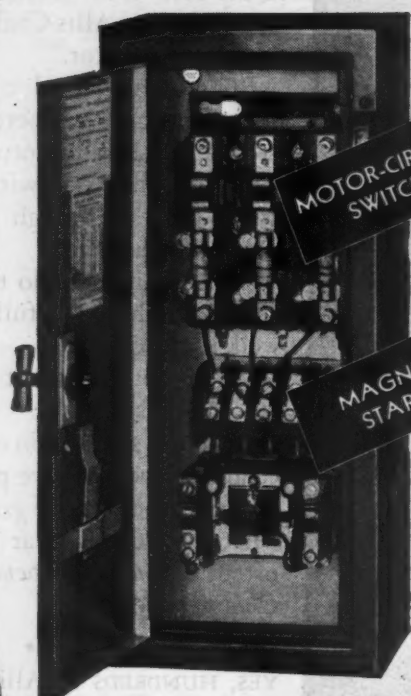
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MOTOR STARTERS



**BOTH
IN ONE
UNIT**



Showing door closed

USE COMBINATION STARTERS to save time, save space, increase safety

Whatever your plant's operating conditions, you can get a combination control to fit it. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.

Here are some of the advantages

1. *50% reduction in mounting time*—You mount only one device, not two.
2. *40% reduction in wiring time*—Connect to only 9 terminals, not 15. The switch and starter come already connected.
3. *Increased safety*—Cover cannot be opened while there is power on the starter.
4. *Reliable motor protection*—Protection devices co-ordinated in starter at the factory.
5. *Saving of wall space*—The one device takes less space than two.
6. *Improved plant appearance*—Single, streamlined case—less open wiring and conduit.

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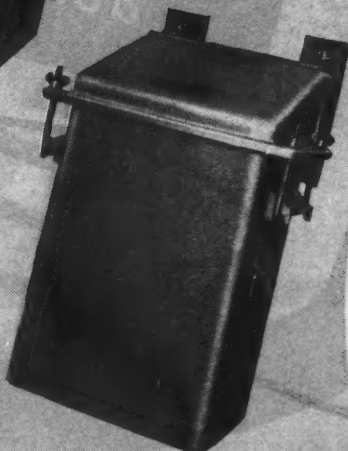
GENERAL-PURPOSE STARTERS

—Suitable for general-purpose, indoor applications where atmospheric conditions are normal.



WATERTIGHT ENCLOSURES

—Suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks. The case is of cast iron, or fabricated steel plate, with a special weatherproof finish and corrosion-proof fittings.



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—Made in two forms—one for corrosive atmosphere and one for hazardous locations. All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.

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Please send me the bulletins checked below.

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- ☐ GEA-3804 Starters for hazardous locations

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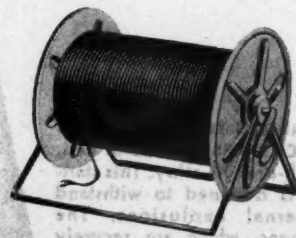
Laytex has been subject to the moisture, heat and humidity of the tropics... the cold of the arctic circle. It has been subject to the shattering shock of the guns on our biggest dreadnaughts.

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I'M SUPER-7-STEEL... THE STRONG MAN OF V-BELTS. MY STEEL CABLES SUPPLY ADDED POWER... GREATLY REDUCE SLIPPAGE CAUSED BY STRETCH



THIS ISN'T AN ACT. I CAN EAT UP 180°F TEMPERATURES ALL DAY LONG. IF THE HEAT'S ON YOUR DRIVES, CALL FOR HEAT-RESISTING SUPER-7



THEY CALL ME STATIC-RESISTING SUPER-7 BECAUSE I CARRY STATIC CHARGES TO MACHINES WHERE THEY'RE GROUNDED.



A LITTLE OIL DOESN'T FAZE ME AT ALL. I'M OIL-RESISTING SUPER-7 ... HANDLING 90% OF ALL OILY DRIVE CONDITIONS.

DON'T WORRY IF YOUR BELTS MUST PRACTICALLY BATHE IN OIL OR GREASE. JUST ASK FOR SUPER-7 OIL-PROOF. I'M MADE OF IMPERVIOUS NEOPRENE.



IT PAYS TO MAKE ALLIS-CHALMERS YOUR V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.



This generator armature has been "Harvelized" by Hanson-Van Winkle-Munning Company. They use Harvel varnish because — (1) bakes quicker — (2) bakes harder — (3) does not become brittle — (4) lasts longer.

THE SECRET OF BETTER INSULATION in a NUTSHELL

FROM the shell structure of the familiar Cashew nut comes a natural phenol which is the basic component of Harvel Insulating Varnishes. The discovery of this unique insulating ingredient which has been utilized by Irvington in the manufacture of a superior insulating varnish is the result of exhaustive research and an experience of over thirty-six years in making all types of insulating varnishes.

Harvel varnishes have many excellent insulating properties which add years to the life of motors, generators, transformers and other electrical equipment. They possess the highest safety factors even when operating under excessive heat, heavy over-loads and in atmospheres where acid or alkali fumes and abrasive materials are present. For example:

Motor failures in a large chemical plant occurred every three months until Harvel varnish was used. Now, three years of uninterrupted service on these same motors is not unusual. This is typical of Harvel performance under extreme conditions.

Harvel reduces the time necessary to produce a unit of electrical equipment by cutting the average baking time in half on applications involving multiple coats.

It polymerizes to a solid infusible state and will not soften or "throw-out" at high peripheral speeds.

Harvel varnishes have excellent dip-tank stability—exceptional penetrating power—and contain no objectionable solvents.

Because the unusual features of Harvel varnishes are not all disclosed by ordinary laboratory methods of testing, why not get these facts first-hand? We will gladly send you a generous sample for testing. See for yourself how Harvel varnishes are superior for use with any type of insulation — for application on equipment wound with Formex and Formvar coated wire, Fiberglass, cotton, asbestos, and paper or enameled wire of all classes.

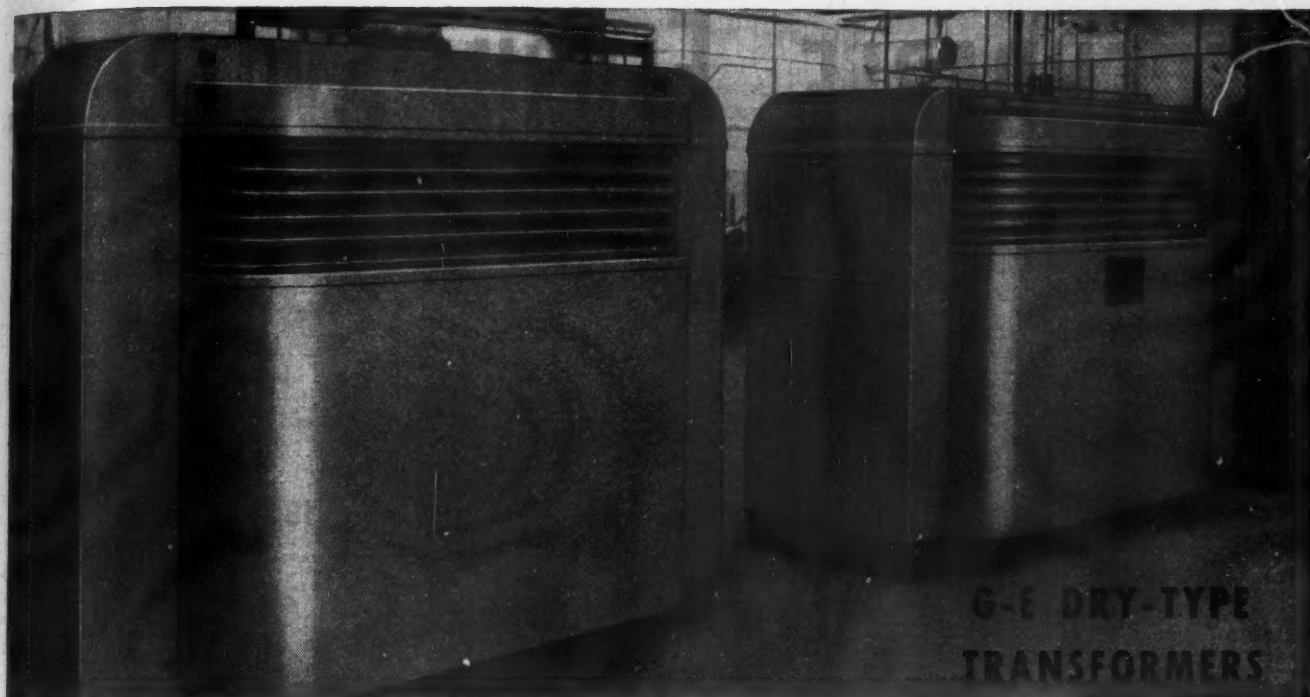
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G-E DRY-TYPE
TRANSFORMERS

As up-to-date as the product they help manufacture—two G-E 150-kva dry-type transformers at a newly equipped factory

6 UNIQUE FEATURES

set new standards for dry-type designs—
in safety, ease of installation, appearance

- 1 A case designed for utility, that is attractive in appearance.
- 2 Completely metal-enclosed construction that prevents rods and wires from being accidentally pushed into live parts of the transformer.
- 3 No exposed live parts, such as bushings, that would necessitate enclosing the unit with a fence to protect personnel.
- 4 Cable terminal compartments completely removable, so that the high-voltage and low-voltage cables can be made up and the unit then slid into place between them without the use of a crane or elaborate hoisting and jacking facilities.

5 Readily removable casing to facilitate inspection and cleaning of the core and coils.

6 Transformers equally suitable for top or bottom connection. Can be equipped with a high-voltage pothead, if desired. Low-voltage terminal facilities are suitable for either cable or bus-duct connections.

These ultramodern distribution transformers are designed to meet AIEE Standards No. 1 for Class B insulation, with 130 C maximum hot-spot temperature in a maximum ambient of 40 C, resulting in an average temperature rise of approximately 65 C. They are now available for use on 601- to 15,000-volt primary circuits, in ratings from 100 to 2000 kva. For further details ask for Bulletin GEA-3714B. General Electric Company, Schenectady 5, N. Y.



Dry-type load-center unit substations are also available. This 750-kva unit steps down 2400 volts to 480 volts at a Southern metals plant.



H-v and l-v terminal compartments are easily removed. They eliminate the hazards of exposed bushings and wiring.

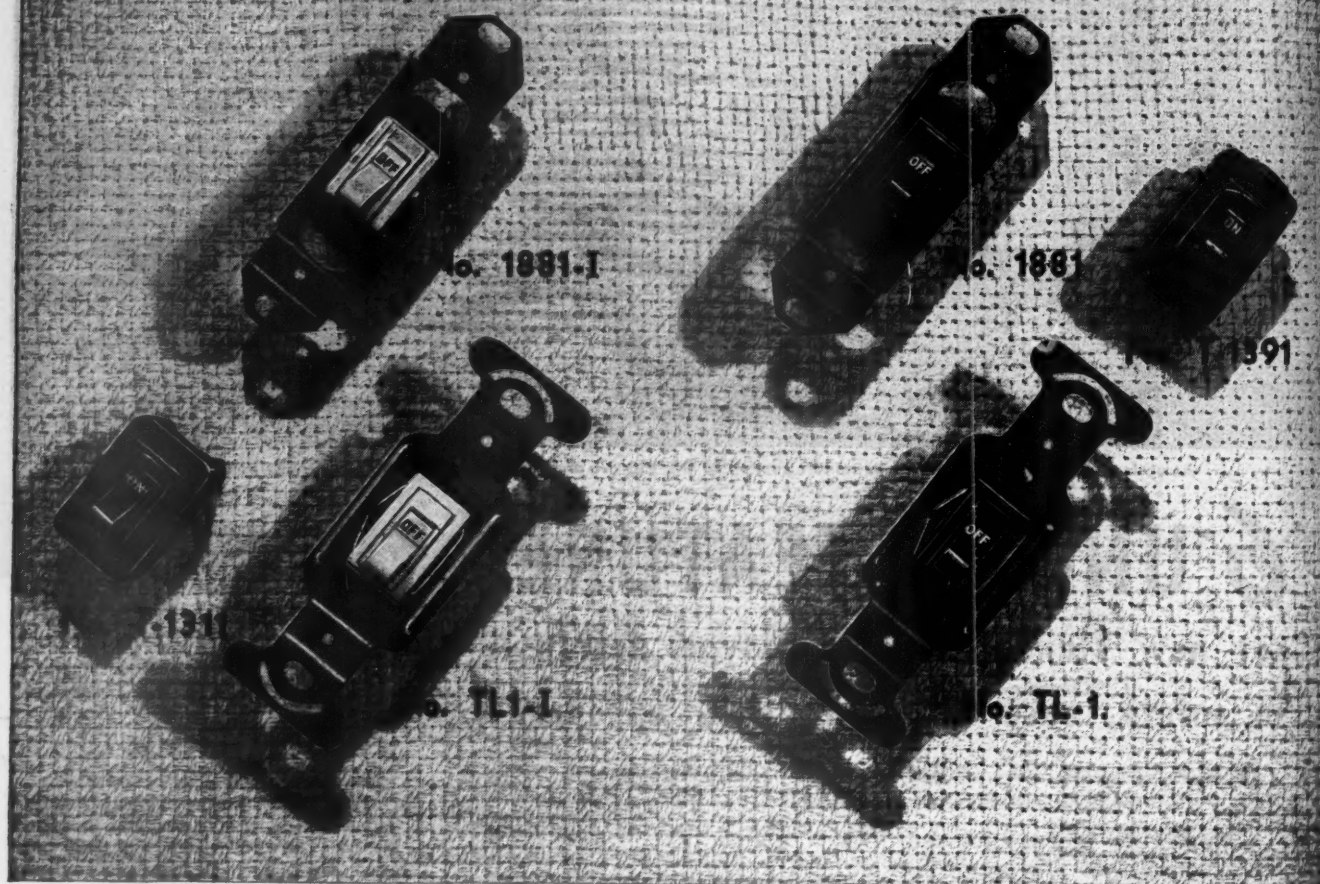


Transforms 2400 volts to 575 volts for machine tools and other factory loads at a New England plant.

GENERAL  ELECTRIC



DEPENDABLE FLUSH SWITCHES



H & H Standard and Interchangeable Lines

These popular numbers provide essential types for "coming through" on residential wiring requirements. Both the Standard and Interchangeable Line switches have the same degree of dependable design and mechanism—the famous H & H "degree".

Numbers illustrated above include representatives of the "TL" Line:- single-pole, double-pole, 3-way and 4-way—residential type. Also, Interchangeable Switches to go with receptacles or other units in a single gang.

HART & HEGEMAN DIVISION

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

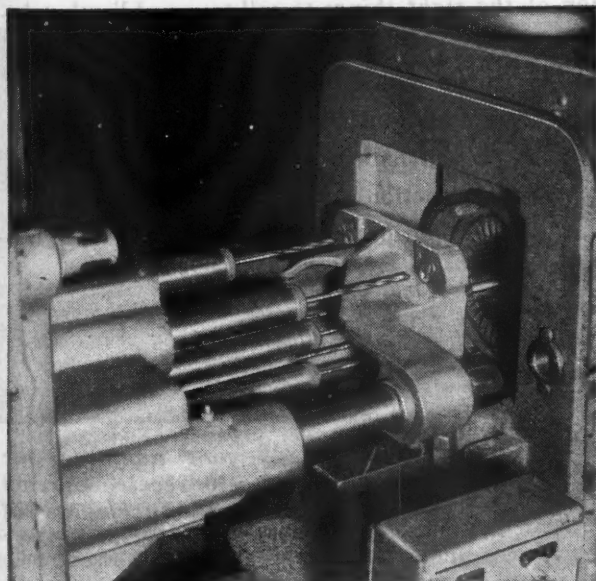
BLESSED BOLT HOLES

It's a blessing to electricians and maintenance men when bolt holes in motor end shields and frames are exactly in line, and mounting holes in the feet are uniformly and accurately positioned. Installation is easier. Interchanging of motors, rotating of end shields, and reversal of stators are all more quickly accomplished. Tight fits are obtained without forcing. Bearing alignment is insured, internal strains are avoided. During the war period, jig-fixture uniformity maintained in machining, drilling, and tapping Tri-Clad motor frames has saved thousands of man-hours of installation and servicing.

End shields are easily rotated for inverted motor mounting.



JIGS AND FIXTURES OF ADVANCED DESIGN MEAN CLOSE FITS IN **TRI-CLAD** MOTORS



Specially built production equipment, as well as test apparatus, helps build Tri-Clad motors with close fits and clearances. Here, all bolt holes in the frame are drilled in a single operation within a rigid fixture that insures accurate positioning. In the finished motor, this results in more accurate shaft alignment, smoother operation, longer bearing life. General Electric's high-volume motor production permits tooling up for high precision without increasing the cost to you. *General Electric Co., Schenectady 5, N.Y.*

Frame-drilling operation at G.E.'s Lynn (Mass.) Works.

GENERAL  ELECTRIC

TRI-CLAD
MOTORS

Buy all the BONDS you can—and keep all you buy.



LOOKING BACK OVER EVENTFUL YEARS JUST PASSED HELPS US PLAN FOR THE IMPORTANT YEARS AHEAD

January is appropriately named after "Janus" of Roman mythology, who had two faces—one looking toward the past, the other toward the future. As we look back over the historic last few years ending with 1944, we realize how powerful the impact of the war has been on all phases of American industry—including the field of lighting and electricity. Here at Spero, for example, realizing our obligation to help win the war, our productive capacity was tripled to supply vital war needs. However, in spite of our war contracts—many of them on products not in our regular line, we have continued to make and supply to wholesalers our five lines of products as nearly complete as possible. We have taken care of our regular customers, and even added new ones. It has been our sincere belief that if we, as manufacturers, ignore the electrical wholesaler in order to make quick profits from war contracts, we are not entitled to his business after the war.

**Spero Products are distributed
only through legitimate electrical
wholesalers.**



SEE US AT BOOTH NO. 14

As we enter 1945, we believe the electrical industry is entitled to a statement as to our policy and plans for the future. As long as the war lasts, we will continue to do our part. Without detracting from our war effort, we will do our utmost to fill orders and speed deliveries of our five regular lines. As industry is today inventing, developing and designing new products that will make the postwar world a better place in which to live, so Spero is planning a line of post-war fluorescent fixtures—for commercial, industrial and residential use—that will maintain Spero's position among the leaders of the industry. Thus our distributors can look forward to a bright future with the ideal combination of *the right things to sell* to a public that is *eager to buy*. Now is the time for jobbers to line up with Spero for a reliable source of the most modern, high quality fluorescent fixtures, reflectors, electrical construction materials, floorlights and vapor-proof units.

**Let us add your name to our
mailing list—to receive current
and future announcements of
new products.**

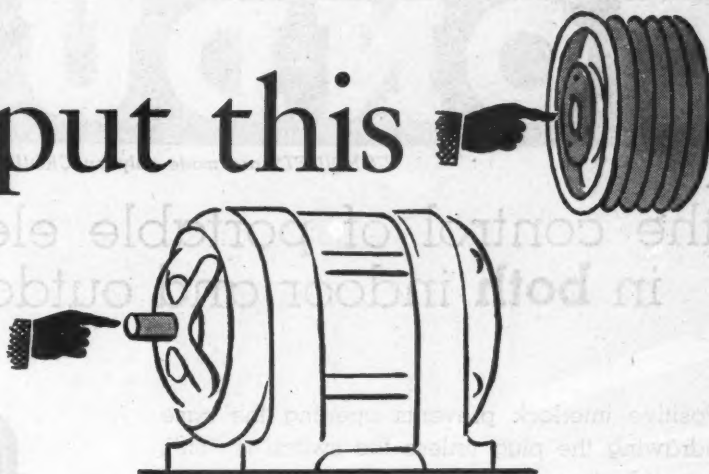


THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

See how Easy

it is to put this

on this



One quick operation and Allis-Chalmers' new "Magic-Grip" — *fastest mounting sheave on the market* — is locked securely to shaft... saving you time, money, trouble!



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no hammering* — *no forcing*! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



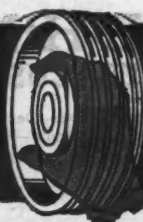
2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge... giving you true alignment with resulting smooth performance. A minimum of time is required.



3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic*! No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1750

Allis-Chalmers Texrope
"MAGIC-GRIP"



SHEAVES

It's new! It's heavy duty! It's raintight!

Type WMKS Interlocking Safety Switch and Plug Receptacle

CONDULET

(CONDULETS are made only by CROUSE-HINDS)

for the control of portable electrical equipment
in **both** indoor and outdoor locations.

Safety. Positive interlock prevents opening the case or withdrawing the plug unless the switch is "off". Switch can't be turned "on" unless the case is closed and the plug fully inserted.

Switches. Motor circuit switch. Quick make and break. Double break, reinforced, positive pressure-type blade and jaw construction. Positive pressure fuse clips. Combination solder or solderless wire lugs. 2 or 3-pole fusible.

Plug Receptacles. Style I is grounded through the shell. It will take the plugs used with the former Type MKS of the same rating. Style II is grounded through an extra pole and the shell. An eyebolt and wingnut prevents accidental withdrawal of the plug when the switch is open.

Cast metal case. Strong and durable. Four sturdy mounting feet. Many possible threaded hub arrangements for both vertical and horizontal conduit. Cover may be padlocked to prevent unauthorized entry. Operating handle may be padlocked "on" or "off".

Threaded operating shaft. Bearings permanently lubricated to resist corrosion and prevent the entrance of dust and moisture.

Horse-power ratings. 2 through 50 H. P.

30, 60, 100 or 200-ampere. 230 or 575 Volts A. C.



Type WMKS
Interlocking
Safety Switch
and Receptacle
Condulet with
Type DP
Interlocking
Plug

Listed in Condulet Catalog No. 2500, Section 50, Pages 21 and 22



CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City—Los Angeles—Milwaukee—Minneapolis—New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington. Resident Product Engineers: Albany—Atlanta—Charlotte—New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.



CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS

Leader

industrial lighting service

A Step Ahead!



**POSTWAR
LIGHTING**

LEADER ENGINEERS WERE ASKED TO COOPERATE ON A LIGHTING PROBLEM

A midwest manufacturer engaged in a terrific production program of Precision Parts for the war effort... and a contract to conduct a school for screw machine operators.

Intensified light source for each machine, required for machining precision parts was accomplished by continuous rows of 3 light 40 watt industrial fixtures spaced to concentrate light output.

A highly satisfactory layout contributing to better personnel relationship and increased production, is the result.

Leader engineers cooperating within the framework of straight line wholesaler distributor merchandising methods have made thousands of such installations all over the country.

THERE IS A LEADER REPRESENTATIVE IN YOUR AREA

Distributed only through the
better Electrical Wholesalers.

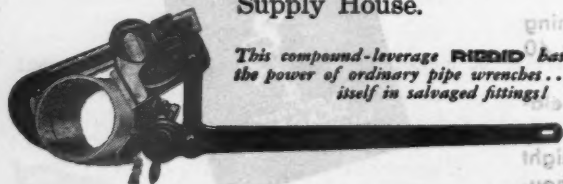
Leader Electric Manufacturing Corporation
6127 BROADWAY, CHICAGO 40, ILLINOIS

Easier work, longer service



with this
**Efficient,
Trouble-proof,
Guaranteed**
RIDGID

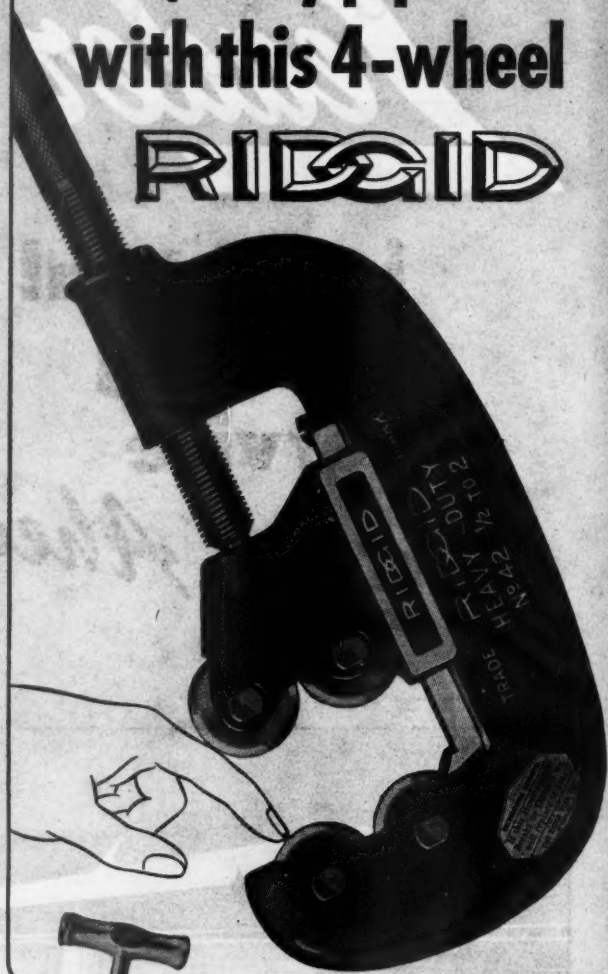
● It's no accident that the **RIDGID** is the favorite pipe wrench of millions of expert users. That unconditionally guaranteed housing that won't break or warp means years of repair-free service. Adjusting nut in open housing spins easily to pipe size. Quick-action jaws won't lock on pipe—handy pipe scale on full-floating hookjaw. Strong comfort-grip I-beam handle. More for your money—and you enjoy using it. Buy it at your Supply House.



*This compound-leverage **RIDGID** has 14 times the power of ordinary pipe wrenches... pays for itself in salvaged fittings!*

Fast, easy pipe cuts with this 4-wheel

RIDGID



Cuts cleanly with a quarter turn

● In tight places it's a wonder. Short handle—and 4-wheels mean swift clean easy cuts, which you'll enjoy also where there's plenty of room to work. A beautifully balanced husky cutter that doesn't fool around, the stout frame making the special heat-treated steel wheels always cut true. Two sizes: No. 42, 1/2" to 2"; No. 44, 2 1/2" to 4". Buy it for better cutting and long service—at your Supply House.



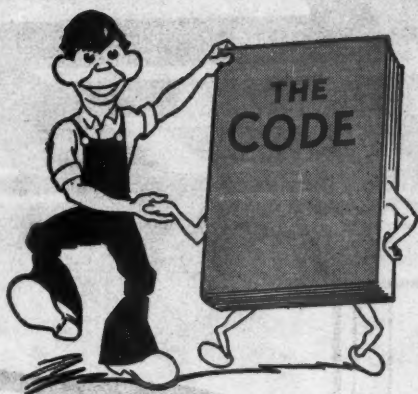
*Regular **RIDGID** Cutter has fast cutting thin-blade wheels.*

RIDGID

Millions of **RIDGID**
Tools in use

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.



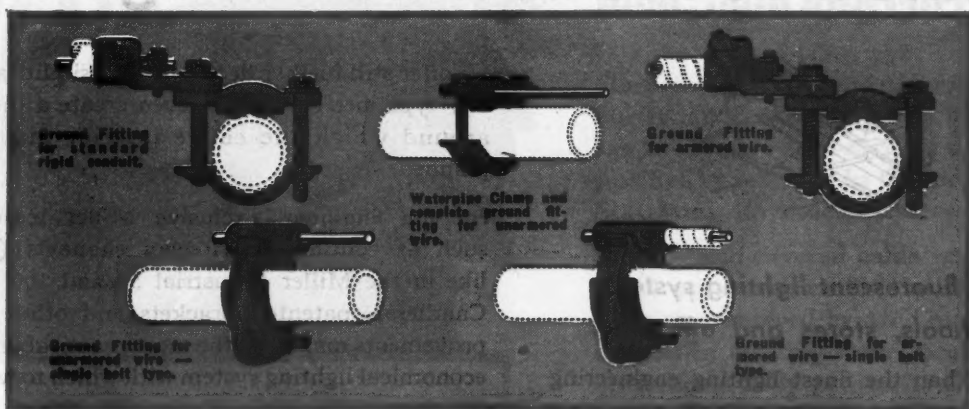
**YOURS FOR EASY
COMPLIANCE WITH
THE CODE**

T&B APPROVED GROUND FITTINGS WITH BUILT-IN SOLDERLESS CONNECTIONS

They meet all Code requirements, keep peace with the Inspectors and assure you of a perfect grounding job.

They simplify your problem of selecting the right fitting for each particular situation. T&B

Ground Fittings* are made for *any* waterpipe up to 6" and *any* Approved grounding conductor—bare, insulated, or armored—or in standard rigid conduit.



The Interchangeable Hub-and-Clamp style enables you to make up unusual as well as standard assemblies. They, together with the T&B Single Bolt styles, also Approved by the Underwriters Laboratories, will do all your grounding jobs with ease, speed and safety.

No solder. Just a screw driver.

If this news is good enough to write home about, just drop a line to our Home Office for Bulletin EC-7 for engineering data, grounding accessories, and catalog chart.

Distributed, like all other T&B products, exclusively through the competent sales organization of T&B Electrical Wholesalers



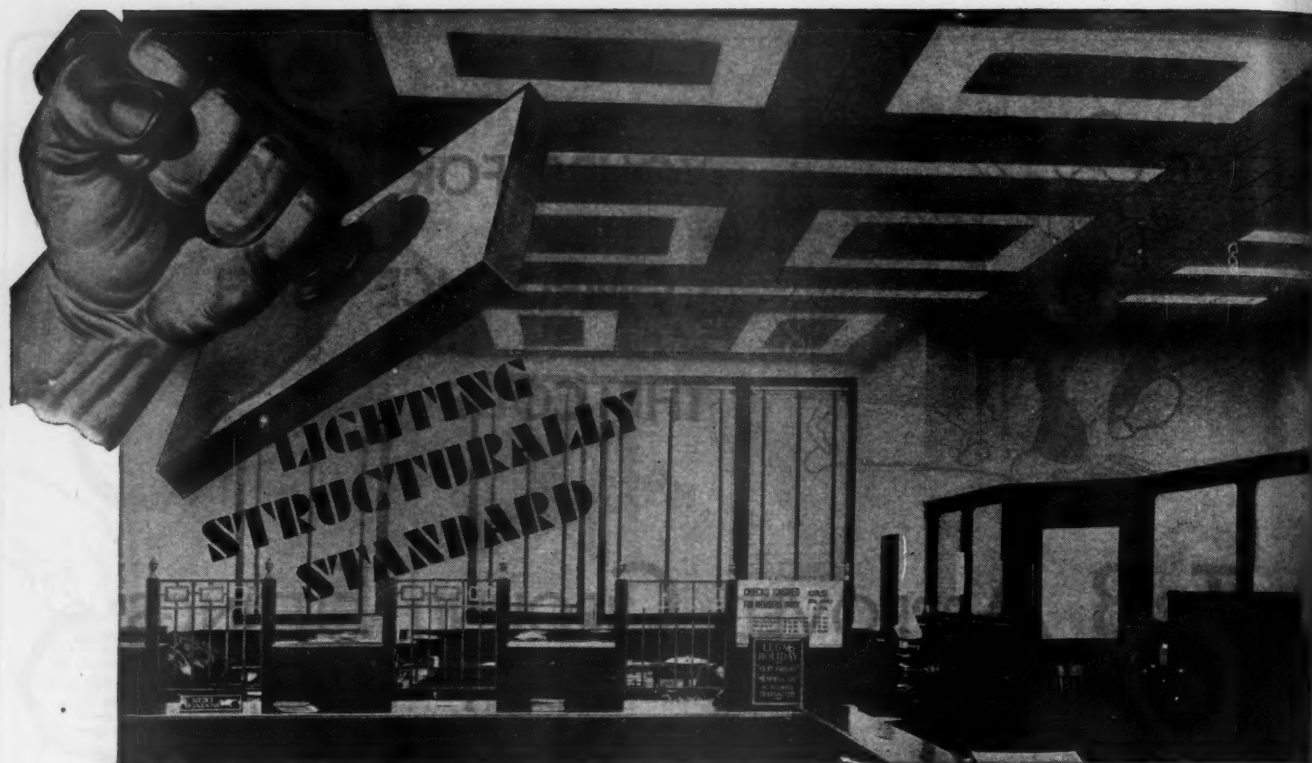
THE THOMAS & BETTS CO.

INCORPORATED
manufacturers of electrical fittings since 1899

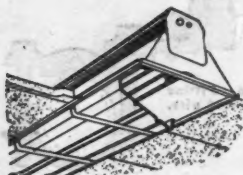
ELIZABETH, N. J. NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal





But applications unlimited as the architect's ingenuity!



Miller fluorescent lighting systems for schools, stores and offices...

are more than the finest lighting engineering can provide. They also open brand new vistas in esthetic design and functional planning.

For the Architect, Miller fluorescent lighting system applications are practically unlimited. They are equally harmonious and practicable as single units, blocks of units, in geometric patterns—and even as light-strips “by the mile”.

The wide range of plastic and glass dishes... prismatic glass plates... metal or plastic grilles

... offer still further decorative possibilities for any type interior—or can even create a theme around which the entire interior may be planned.

For the Engineer, exclusive Miller features such as continuous wireway channels (just like in the Miller Industrial 50 and 100 foot Candles); patented brackets and other improvements make this the most practicable and economical lighting system with which to work.

For Example: Using the Miller method, “fixtures” are *not* hung from the ceiling—but the *ceiling* is hung from the *lighting system*!

There is much more to the fascinating story of Miller fluorescent lighting systems—so call a Miller Representative (they're in principal cities)—and see what our 100 years' work with all proven light sources has taught!

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel



Lighting our airfields all over the world...

WIRE WITH
WALKER

WALKER LEAD-COVERED CABLE

WINS against

heat, cold and corroding soils

Sunk in corroding mud of South Sea islands, buried under Arctic ice and burning desert sand—Walker lead-covered cable has fully justified its selection by the Air Corps to help in lighting our widely-scattered airfields.

Walker lead-covered cable was designed to stand up strong under the severest conditions encountered in Air Corps service. Its success in meeting these most exacting requirements fully proves its ability to withstand all soil and climatic extremes to be found anywhere in this country.

Walker of Conshohocken offers a complete line of lead-covered cable—furnished in Solid Conductor from 16 gauge to 8 gauge, and in Stranded Conductor from 14 gauge to 500,000 circular mils.

Ask your local distributor about prices and deliveries. For further information, write to Walker Bros., Conshohocken, Pa.

OTHER DEPENDABLE WALKER PRODUCTS

Rubber-covered, Synthetic and Lead-covered Wires & Cables
"Walkerflex" Non-Metallic Sheathed Cables
Service Entrance Cables
Automotive Wires and Cables
Shipboard Cables—Lead-covered, Non-Lead-covered,
Synthetic or Varnished Cambric Insulation
Electric Metallic Tubing
"Duralcote" Rigid Steel Conduit
"Preset-Insert" Underfloor Distribution Systems

YOU CAN ALWAYS Rely ON RACO

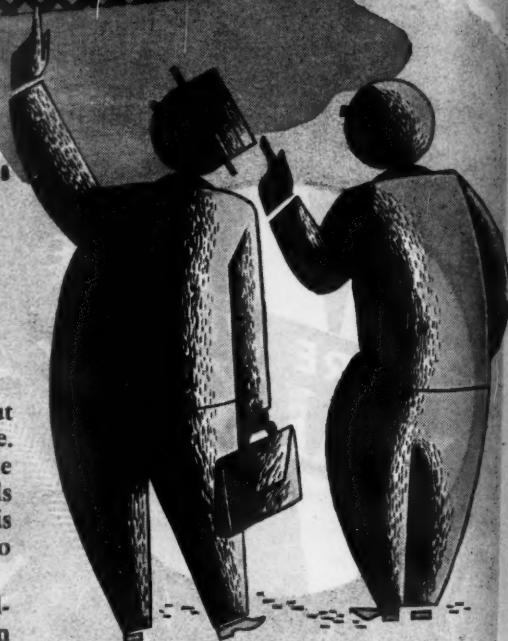


RACO ALL-STEEL PRODUCTS

DIVISION OF

ALL STEEL  EQUIP COMPANY

*"That's the house that
will get my Business!"*



MANY successful contractors throughout America prefer the Raco • All-Steel • Line. They know, from experience, that Raco is the mark of better workmanship, finer materials . . . that Raco is the dependable line that is accepted by architects and builders . . . that Raco products help win approval of their work.

More than 31 years of engineering and product improvement have kept Raco • All-Steel in step with the latest developments in the electrical wiring field, have provided better products for all types of construction: new and old building, repair and maintenance jobs. Raco • All-Steel has been in use for years on many of the nation's largest and most technical jobs.

Remember . . . you can always **RELY** on **RACO!** Look for the Raco trade-mark. It's the quality line that is attractively packaged and **sold only through wholesalers.**



COB1 — The Popular "CO", 4" Square Box with a convenient bracket.

DO-21-N3 — Completely protects non-metallic cable entering through side or bottom. Clamp is one piece.

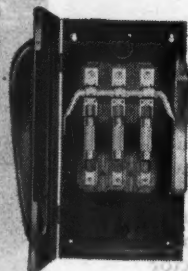


ALL-STEEL-EQUIP COMPANY, INC.

600 Kensington

Aurora, Illinois

Distinguished!



Vacu-Break

SAFETY SWITCHES WITH "CLAMPATIC" CONTACTS

There are many valuable *plus* features in Bulldog Safety Switches, but none of them increases the *price you pay*.

There is the exclusive Vacu-Break principle of arc suffocation . . . the Clampmatic feature which assures "on" contacts as tight as a bolted connection . . . and the distinguished style of cabinets which

combine modern beauty with extra utility.

Such advantages, backed by the Bulldog reputation for invariably fine workmanship, account for the fact that a majority of buyers who insist on the *best* are among Bulldog's customers.

Capacities from 30 Amp. to 1200 Amp., 2, 3 and 4 Poles, 575 Volts and less.

BULLDOG

ELECTRIC PRODUCTS COMPANY



Buy More War Bonds

Buy More War Bonds

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN

In Canada: Bulldog Electric Products, Ltd., Toronto

Field Engineering Offices in All Principal Cities

Also Manufacturers of
SoftFuse Panelboards — Switchboards — Circuit
Master Breakers—BUStrihution Duct, for "plug-in"
power—Universal Trol-E-Duct, for flexible lighting
— Industrial Trol-E-Duct, for moveable "loads."

...still Snowed Under!



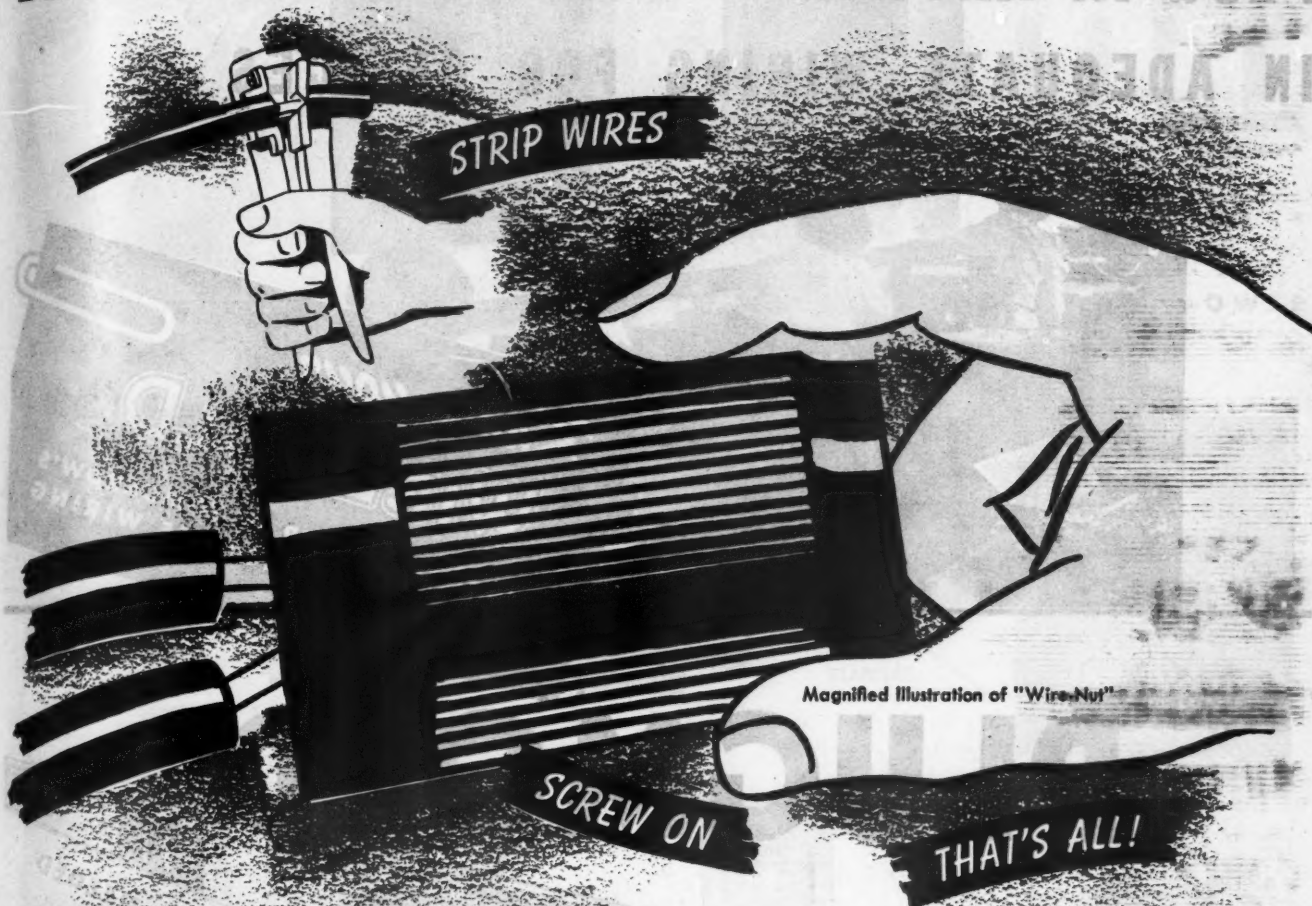
...still Snowed Under!



War demands for Toledo Pipe Tools have "snowed us under"—but we're doing our best to fill these orders with all possible speed. All of your orders to the distributor are being filled in accordance with priority regulations. However, the continued shortage of manpower and materials still means delay to many of our customers. We're sorry—but we know you'll understand it's part of the price of Victory. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

TOLEDO
PRECISION PIPE TOOLS

New Low Prices.... See Your Jobber!



Helping ELECTRICITY Serve America Better

Reconversion Time is Rewiring Time!

IDEAL "Wire-Nuts" (solderless, tapeless, wire connectors) make a neater, safer wire joint... better electrically... stronger mechanically. No fussing. Easy to use, simply strip-wires, screw on... that's all. Recognized as standard throughout the Electrical Industry. Approved by Underwriters' Laboratories, Inc.



IDEAL WIRING DEVICES. Peace-time or War-time, wiring jobs must be finished fast. Each year more and more of these IDEAL Wiring Devices are used to simplify and speed electrical wiring.

- Wire Strippers
- Lugs, solder and solderless
- Fish Tape, Reels and Pullers
- Joist Boring Machine

IMMEDIATELY AVAILABLE

IDEAL "WIRE-NUTS"

New low prices still further reduce the cost of making wire joints in reconversion work—new circuits, rewiring, plant changes, relocating machinery, etc. You can make all wire joints without solder or tape—all you need is a pocketful of IDEAL "Wire-Nuts."

Wire Connectors are only one of IDEAL'S **100 Products** serving more than **40,000 Customers** through **200 Service Engineers**. Warehouses and Jobber Stocks located all over the country.

Send for **FREE 88-page Handbook**, describing IDEAL'S new and better products and methods.

IDEAL Sycamore

PLUG-IN-ANYWHERE CONVENIENCE IN ADEQUATE WIRING FOR OFFICES



Know your
WIREMOLD
BUSINESS BUILDER IN TOMORROW'S
MARKET FOR ADEQUATE WIRING

PLUGMOLD



No. 2100
PLUGMOLD

Capacity: 6 No. 12 R. C. Conductors with
receptacles installed; 10 No. 12 R. C.
Conductors without receptacles.



2127P
3-Wire Polarized
Receptacle



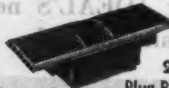
2127H
Midget Twistlock
Receptacle



2121
Telephone Outlet



2127S
T Slot Receptacle



2127
Plug Receptacle

The above typical business office installation of PLUGMOLD clearly demonstrates the fine appearance and time-saving convenience of this proved and practical plug-in-anywhere wiring system. In this case power is supplied to electric calculating machines at each desk in one run of PLUGMOLD, and the other run carries telephone circuits. When desks must be relocated, it is a matter of minutes to install new outlets or relocate those already installed. Industrial type outlets are also available for installations in laboratories, engineering departments and at factory work benches, etc. Investigate this modern way to put electricity at workers' fingertips. Write for PLUGMOLD bulletins and engineering data sheets.



ELECTRICAL CONTRACTORS



Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to **HELP YOU BUILD BUSINESS**. Tie in with this aggressive promotion program.

THE WIREMOLD COMPANY, HARTFORD 10, CONN.



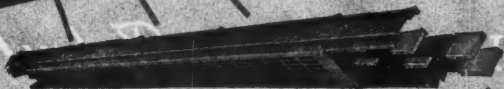


TRUMBULL

DISTRIBUTES •• CONTROLS •• SAFEGUARDS ••

ELECTRICITY FOR LIGHT AND FOR POWER

Trumbull list, a general catalogue of Trumbull products with essential illustrations, is published once or twice a year. We shall be glad to place your name on our list to receive this Trumbull service.



L. V. D. (LOW VOLTAGE DROP)
MAIN FEEDER SYSTEM

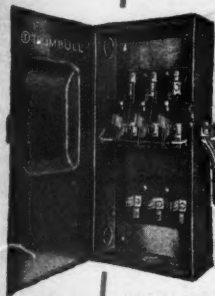


SMALL
MOTOR
STARTERS



CONTROL CENTERS

FLEX-A-POWER
AND FLEX-A-PLUG
PLUG-IN SYSTEM



HEAVY DUTY
INDUSTRIAL
SWITCHES



MANUAL
STARTERS



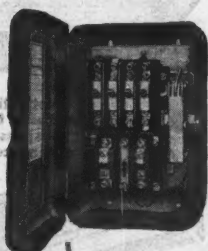
MULTI-BREAKERS



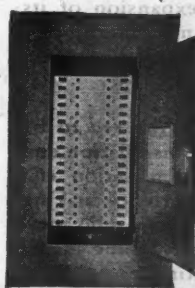
SWITCH AND FUSE LIGHTING
PANEL BOARDS



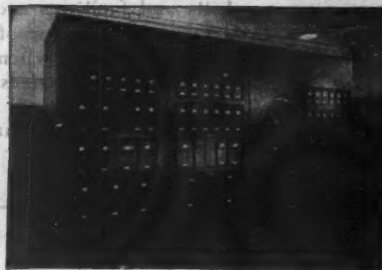
CIRCUIT
BREAKERS



MAGNETIC
STARTERS



MULTI-BREAKER
PANEL BOARDS



SWITCH BOARDS

•Trumbull products cover an unusually comprehensive assortment of material for complete systems of interior electrical distribution and control. This advertisement features only the principal broad groupings of these products. Trumbullaid circulars and bulletins available on request.



THE TRUMBULL NAME PLATE IS KNOWN TO ELECTRICAL MEN IN EVERY BRANCH OF THE FIELD.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CONN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

PREVIEW OF *Tomorrow's* PERMAFLECTOR FLUORESCENT LUMINAIRES... *Today!*

**Stimulating beauty added to
fluorescent efficiency ... and
engineered for ease of installation
and maintenance**

In addition to constant production of vital war material, Pittsburgh Reflector Company has continued the improvement and expansion of its standard products. Now, these new, more beautiful and more effective Permalector Fluorescent Luminaires are ready!

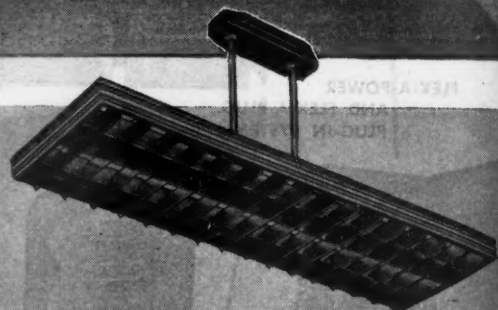
Designed to be beautiful, engineered to be practical, they combine ease of installation and maintenance with maximum illumination efficiency. Thirty-two years of experience making better commercial lighting fixtures, plus new skills and facilities acquired in wartime manufacturing, assure you of the "ultimate" in Fluorescent perfection when you specify Permalector Fluorescent Luminaires.

Write for full information.

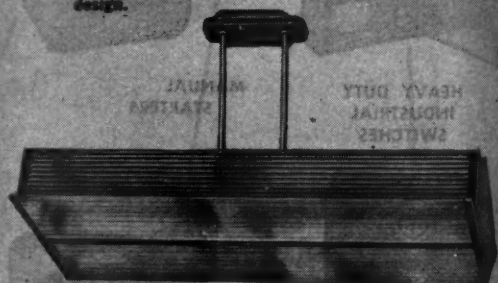


Incandescent or fluorescent... which?

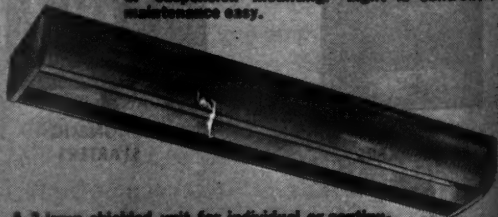
Neither Incandescent nor Fluorescent lighting, individually, is a cure-all for every illumination problem. Always consult your Permalector engineer to secure the right type, or combination, for each application. Pittsburgh Reflector Company manufactures both types and can give you unbiased recommendations.



Stunningly new all aluminum, shielded type, 4-40 watt Luminaire for individual or continuous mounting, embodying drastic new principles of design.



A stimulating glass, shielded type, 4-40 watt Luminaire for individual or continuous surface or suspension mounting. Light is controlled; maintenance easy.



A 2-lamp shielded unit for individual or continuous surface mounting—it's different from anything you have seen.

**Pittsburgh
REFLECTOR COMPANY**
OLIVER BUILDING • PITTSBURGH, PA.

Manufacturers of Permalector
Lighting Equipment

FOR SAFETY'S SAKE . . . USE CONDUIT (Full Weight Rigid Steel)

Replace "Emergency" Wiring with **DEPENDABLE** Systems

WHENEVER a wartime building project is to be used for long-term, peacetime work, make sure that dangerous, short-lived wiring systems are replaced.

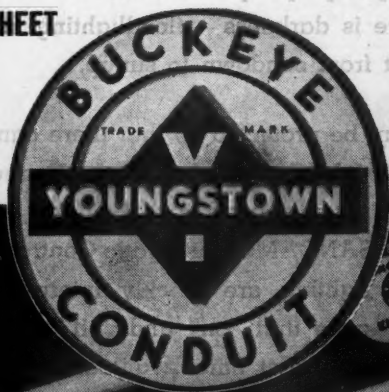
Replace all "emergency" systems with full-weight, standard-threaded, rigid steel conduit systems like the one shown here, and you can stake your reputation on their performance.

Youngstown's full-weight, standard-threaded, rigid steel conduit, long known everywhere under the familiar name of **BUCKEYE**, meets every exacting requirement of the National Electrical Code, furnishes full, permanent protection against dust, dirt, moisture, vapors, vibration, explosion, or other damage.

For maximum dependability, always specify **BUCKEYE** conduit. You can get it now through regular distributors.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of
CARBON, ALLOY and
YOLOY STEELS



Ask your distributor for
Pipe and Tubular Products - Sheets -
Plates - Bars - Conduit - Coke Tin
Plate - Electrolytic Tin Plate - Rods -
Wire - Nails - Tie Plates and Spikes

Bright

ACROSS THE NIGHT...



SANGAMO TIME SWITCHES FOR FLOODLIGHTING PROTECTION

• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSW2 Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

WHERE THERE IS A NEED FOR
FLOODLIGHTING
THERE'S A SALE FOR AUTOMATIC
CONTROL

When floodlighting is turned on it is done so for a reason — the safeguarding of property. There can be no letdown anytime as long as there is darkness — floodlighting must be on clear across the night from sundown to sunup.

Floodlighting can be protected so that there can be no failures. It is done with SANGAMO Automatic Control. This means added sales, for when you sell floodlighting, you can also sell SANGAMO Automatic Control. Buyers of floodlighting are quickly interested in the assurance that "on" and "off" operations occur at the exact times wanted.

Catalog No. 1000 tells about installation—range of application—construction and complete range of types. Write for it!

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

IF IT'S PARANITE

IT'S RIGHT



**ELECTRIC WIRES and CABLES
BETTER THAN CODE
REQUIRES**

PARANITE WIRE AND CABLE CORPORATION

Division of
ESSEX WIRE CORPORATION
FT. WAYNE, INDIANA

THIS NEW FARADAY SIGNAL CATALOG

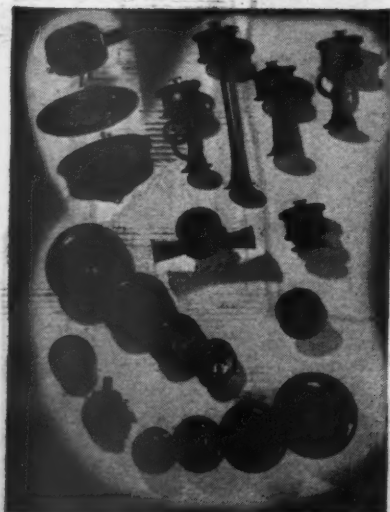
Can save you hours of searching!



**104 pages of
Up-to-the-Minute
Facts on modern
industrial signals**



THE HOUSE
OF SIGNAL SERVICE
SINCE 1884



• Complete! • Conveniently Indexed! • Easy to Use!

Not a revised edition—not a made-over job—but a brand new, amazingly convenient, complete and up-to-date manual of all that's newest in the field of industrial signals! It represents years of experience, months of preparation, thousands of dollars invested to make your buying job easier—and it's yours for the asking!

UNI-PACT—the quick-change signal system

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flat and straight prior to welding strips and in end,
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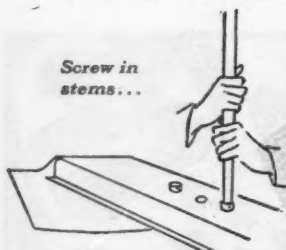
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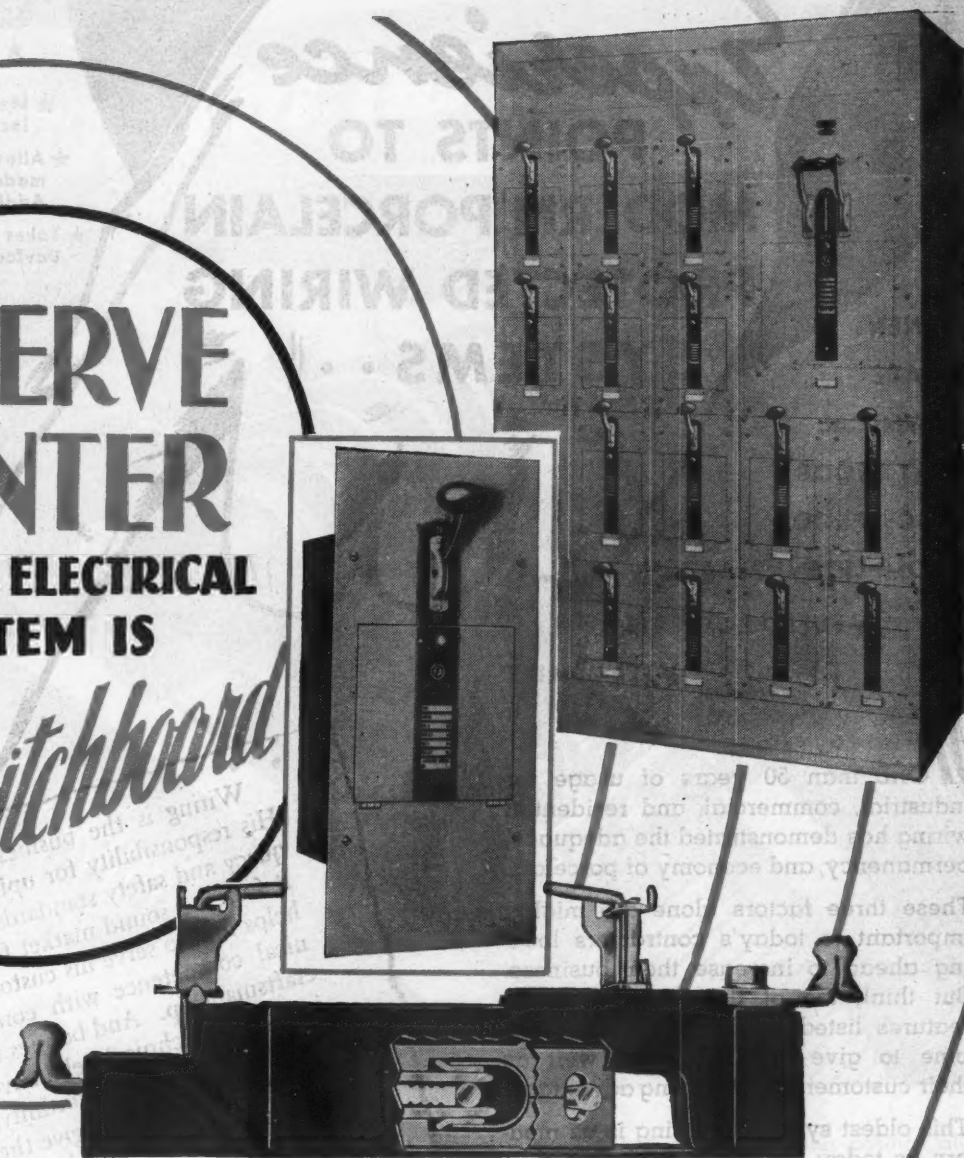
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from a lead editorial
in **ELECTRICAL CONTRACTING**
September 1944 by Wm. T. Stuart

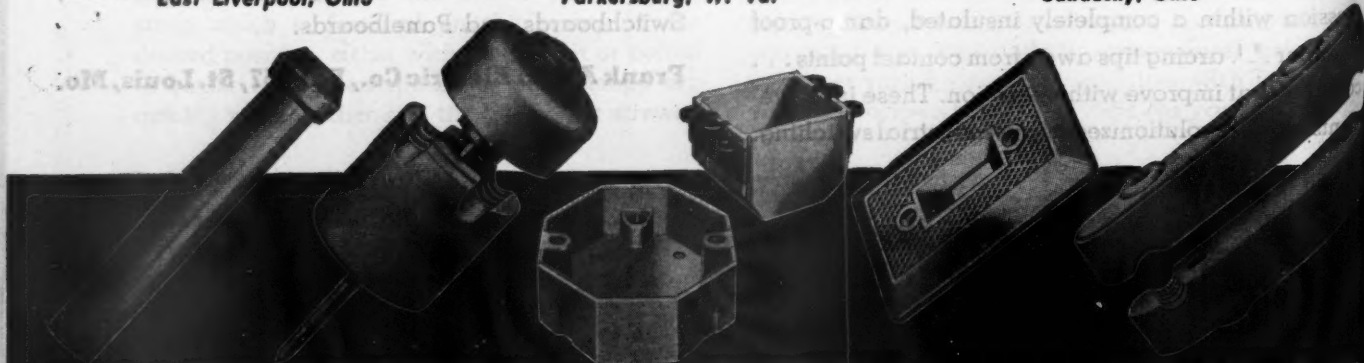
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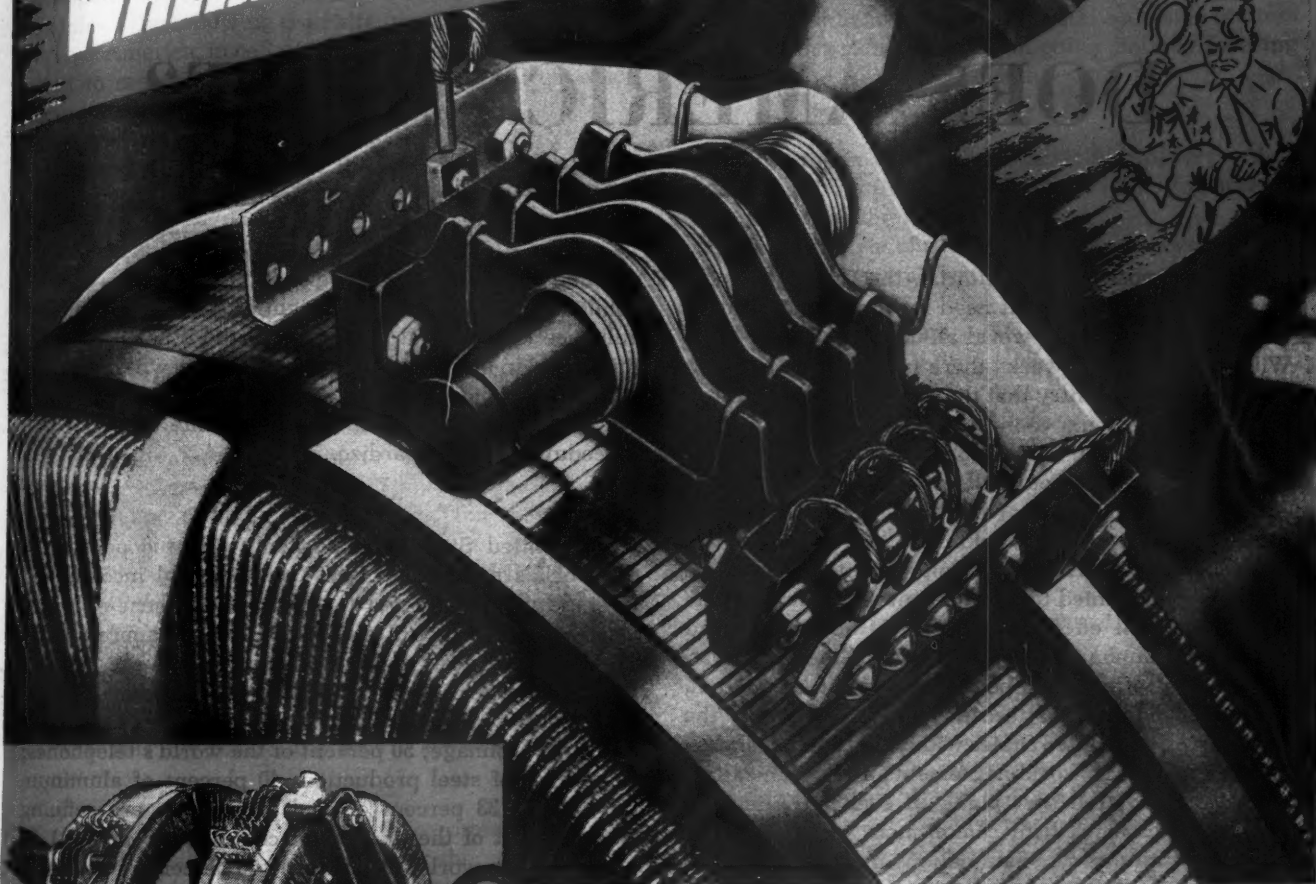
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WHAT DOES AMERICA WANT?

IT IS THE PURPOSE of this editorial, the thirty-first of a series, to state the urgent need for a clear declaration of American policy in world affairs.

Within the past few weeks there has been a wakening conviction in this country that the determination of international arrangements cannot safely be put aside until victory has been won. For we have seen actions taken in Europe seemingly without full consultation and agreement of the Allied powers, which may profoundly affect the design of the post-war world.

A declaration of American policy is needed, and it should be accompanied by a statement of our firm intention to exert full effort to procure its acceptance and furtherance. Emphatically, this does not mean that an American platform should be put forth as an ultimatum, which other nations must accept totally, or reject at the cost of having the United States withdraw from collaborative participation in world agreements and organization. On the contrary, the first plank in such an American platform should be a firm commitment on our part to participate with our associate nations in building a general system of world security and order. By definition, this requires that each participant be willing to accommodate its purely national interests to a program that can be accepted as fairly representing the interests of all. But equally, there is imposed on each participant an obligation to state honestly and openly what it conceives its individual interest to be, as well as its concept of what measures will best serve the general interest.

Americans have displayed a singular diffidence in the matter of formulating a bill of American objectives—singular, in that it contrasts so sharply with our power to exercise as broad a leadership as we are able to define. This reluctance stems partly from the inherent difficulty of arriving at a coherent statement of national aims in a country like the United States—so vast in area, so multiple in its sectional and group interests, and so soundly committed to the free expression of individual thought. But it stems also, in part, from a tradition of national isolation which, however understandable in historic perspective, now stands clearly discredited by two world wars which were not of our making, but from which we were unable to hold aloof.

That the economic wellbeing and political security of the rest of the world is closely bound to the decision and performance of the United States is questioned nowhere but in America. Political boundaries and restrictions can-

not build effective fences against the interplay of economic forces, and the sheer weight of American economic influence is of crucial import to all the other nations of this globe. In large measure their decisions will be shaped either in response to the opportunities that our procedures offer them, or in defense of interests that our procedures may jeopardize.

★ ★ ★

The United States contains only about 6 percent of the world's population. But—our national income, before the war, amounted to almost 25 percent of world income; our industrial output as a whole approximates 45 percent of world totals, and we now are producing a like percentage of the world's munitions; we have 35 percent of the world's railroad mileage; 25 percent of merchant fleet tonnage; 50 percent of the world's telephones; 45 percent of steel production; 40 percent of aluminum production; 33 percent of coal output; we are refining (though part of the production comes from imports) 55 percent of the world's copper, and 70 percent of its petroleum; we now are producing 50 percent of the world's rubber (though post-war resumption of natural rubber production will sharply reduce this balance); our shares of agricultural production are, of course, much smaller, but just before the war we accounted for 35 percent of world cotton production, 15 percent of wheat, and 10 percent of wool.

Whether we like it or not, we must exercise political responsibilities commensurate with the weight of our economic power in an inter-dependent world. But before responsibilities can be assumed, they must be defined. Can the United States arrive at a clear agreement and statement of aims for which it is willing to stand sponsor?

The recent campaigns of both political parties have helped to provide an encouraging answer. In general, election mandates are glaringly deficient as indicators of a unified national purpose. A majority of voters declare themselves for the winning candidate. But even among the majority there are varying degrees of enthusiasm for the platform principles espoused by their candidate; and the substantial minorities of the defeated parties may have had no enthusiasm whatsoever for particular planks in the winning platform, or for the platform in its entirety. A sportsmanlike deference to the will of the majority is a feeble substitute for unified national conviction.

But this Presidential campaign was noteworthy for certain basic principles upon which both the platforms and the candidates of the major political parties were

united. Surely, upon such areas of agreement there may be said to have been an American mandate; the more so, because upon certain of them, we have evidence that no party or candidate could have declared opposition with any hope of victory. What then were these agreed-upon principles? The following is an attempt at a fair summary:

1. That America, in collaboration with its Allies, is committed to seeing the war through to the unconditional surrender of our declared enemies.

2. That America is committed to a responsible role in a world security system after the war, including a commitment to lend the support of our armed forces to repel aggressions that may violate such security.

3. That America is committed to the post-war goal of substantially maintaining in this country an economy that will provide jobs for those who are able and willing to work.

4. That America is committed to the principle of achieving this goal of sustained, high-level employment of manpower and economic resources under a system primarily activated by competitive enterprise.

These are American mandates. They can be made the nucleus of a coherent national policy, for they define aims upon which the great majority of our people are emphatically agreed. But no one can pretend that in this generalized form they serve as more than directional guides for either internal legislation or international negotiation. This skeleton of aims must be clothed with the living flesh of agreed-upon means. Here we have no national mandates of comparable clarity, but it is patently clear that it is our compelling task to achieve them.

★ ★ ★

On our elected representatives in government rests the primary responsibility for formulating the specific programs required to implement national policies. Under our system of government, those representatives need continuous nourishment in the form of mandates as to what the people want. Particularly during a period when so many urgent problems are being thrashed out upon an international basis, this imposes a grave responsibility upon all sectors of our citizens; for it requires them to think in terms of the welfare of our nation as a whole, to focus upon those points which offer possibilities for substantial agreement among Americans, rather than upon matters of individual, group, or sectional advantage.

In earlier editorials I have tried to define a basis for national policy in keeping with that broad purpose. They have dealt with problems that are basic to the healthy functioning of free enterprise under the competitive system, with the mobilization of our resources for war and for reconversion to peace-time production, with labor and management responsibilities and relations, with national debt and taxation, with foreign trade and our economic relationships abroad, with the industrial development of backward areas. Since they have been presented in the McGraw-Hill publications, which reach a group broadly representative of all American industry, they have centered upon problems that have an economic rather than a strictly political import.

Future editorials, to appear during 1945, will deal with

comparable subjects selected in recognition of the urgent importance for arriving at concerted definitions of national policy. I am fully aware that no individual or group can speak authoritatively for the American Nation. But I hope that an honest attempt to formulate sound concepts of national interest in crucial economic matters will help to crystallize American policy both by focusing agreement and by eliciting dissent.

★ ★ ★

Here there is space only to indicate in broadest outline what I conceive to be desirable foundations for an economic policy for the United States:

1. The attainment of a high and sustained level of business activity and employment in the United States and in the world.

2. Active and expanding markets for world trade based upon fair competition rather than upon bloc agreements, discriminatory preferences, and cartel arrangements.

3. The encouragement of industrial development in nations that have been backward in that respect.

4. A recognition that hospitality to imports, rather than constituting a threat to national standards of living, offers in fact the most potent instrument for international bargaining that any nation can command.

5. A willingness to assume a responsible national role in international arrangements designed to provide such financial stability as may be needed to support mutually advantageous world exchange of goods and services.

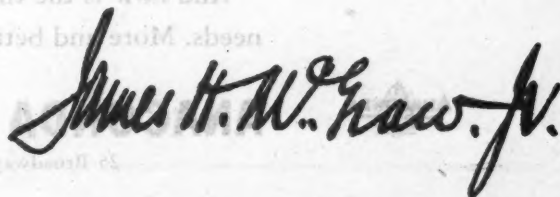
We must see to it that the end of military warfare does not merely open the door to an era of economic warfare.

The fact is that America has no choice but to assume leadership in world affairs. For the weight of our influence will be felt by other nations no less whether our attitude be positive or negative. And the cost to us of any international obligation which we might undertake must in all fairness be weighed against the equally real cost to us of dealing with measures that others may take to protect themselves against the results of our non-participation.

We have tended in the past to approach international commitments timidly, fearful that we might be outwitted in a world battle of wits. And in so doing, we have too often ceded to others the initiative of suggestion, leaving to ourselves the thankless task of accepting or rejecting what they demand of us.

Our one bargaining weakness stems from the fact that other nations, by contrast feeble in potential power, know what they want and are able to mobilize all their strength to achieve it.

America can be the most effective nation on earth — if only it knows what it wants.



President McGraw-Hill Publishing Co., Inc.

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Obviously, adequate wiring will be essential. The wider the recognition of this, the better business for everyone... utility, contractor, wholesaler, manufacturer.

And now is the time to lay the foundation for tomorrow's electrical needs. More and better wiring should be a part of every postwar plan.



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YEAR FOR DECISION

In other times we should talk about the bright New Year and its golden opportunities. That is the custom. That is usually the way our thoughts turn as we clamp fresh new sheets in our calendar pad. It is different this year. Time, to most of us, is no longer measured by methodical numbers that mark the passing of another day or another year. It is recorded by yards and miles of progress against the enemy. It is measured by production figures of planes and ships or by casualty lists in the morning papers.

We enter 1945 fighting a grim and bloody war. Shortages in vital materials, we are told, will lengthen the struggle and cost lives. Critical manpower shortages at home are closing the doors on hopes for an early revival of civilian production or any but the most vitally essential construction. Complacency, though much talked about, is hardly evident. There is a growing tendency, in fact, to project the urgent needs of the day into our thinking about the future.

That is another kind of complacency. It shows up in a reluctance to draw sound plans. It is evident in the present tendency to withhold the announcement of postwar projects and products. It is a dangerous kind of complacency because it is the easy way to postpone the responsibility for deciding now on a course of action. And 1945 is clearly a year of decision.

This year we shall revise the National Electrical Code. That revision will set the rules under which postwar wiring must be installed. Here is a practical and typical example of a course of action under which decisions

must be made now that will affect substantially all of us. Those decisions cannot be made against the backdrop of war, of material scarcity and manpower shortage. They must be made in terms of an expanding peacetime economy.

In 1945 we shall see a lighting exhibition in Chicago. It will show the progress of lamps and fixtures. It will point the way to postwar uses of modern lighting equipment and techniques. It may well mark the turning point of a new era in lighting progress. Decisions must be made today by electrical men everywhere about how they, their companies, and their industry groups are going to cooperate with this great project. Plans must be laid for bringing the proceeds of this exhibition back to every community. It can mean lighting progress, better living standards, sound business and jobs. Here again our decisions cannot be inhibited by the news of the moment or the tactical fortunes of war. They must be vigorous, confident and bold.

We repeat—this is not a bright New Year. Our main job is still winning the war. But plans and decisions for the postwar economy must go on—with imagination and courage enough to look beyond today's limitations.

Wm. J. Stuart

Electrical Contracting

JANUARY, 1945

Executive Office: 420 Lexington Ave., N. Y. 17, N. Y.

Post-war pipe dreams your customers can't count on

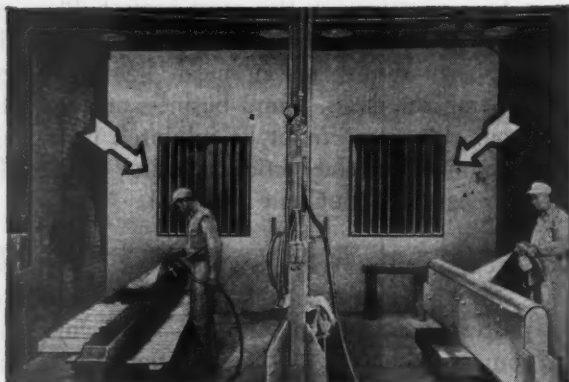
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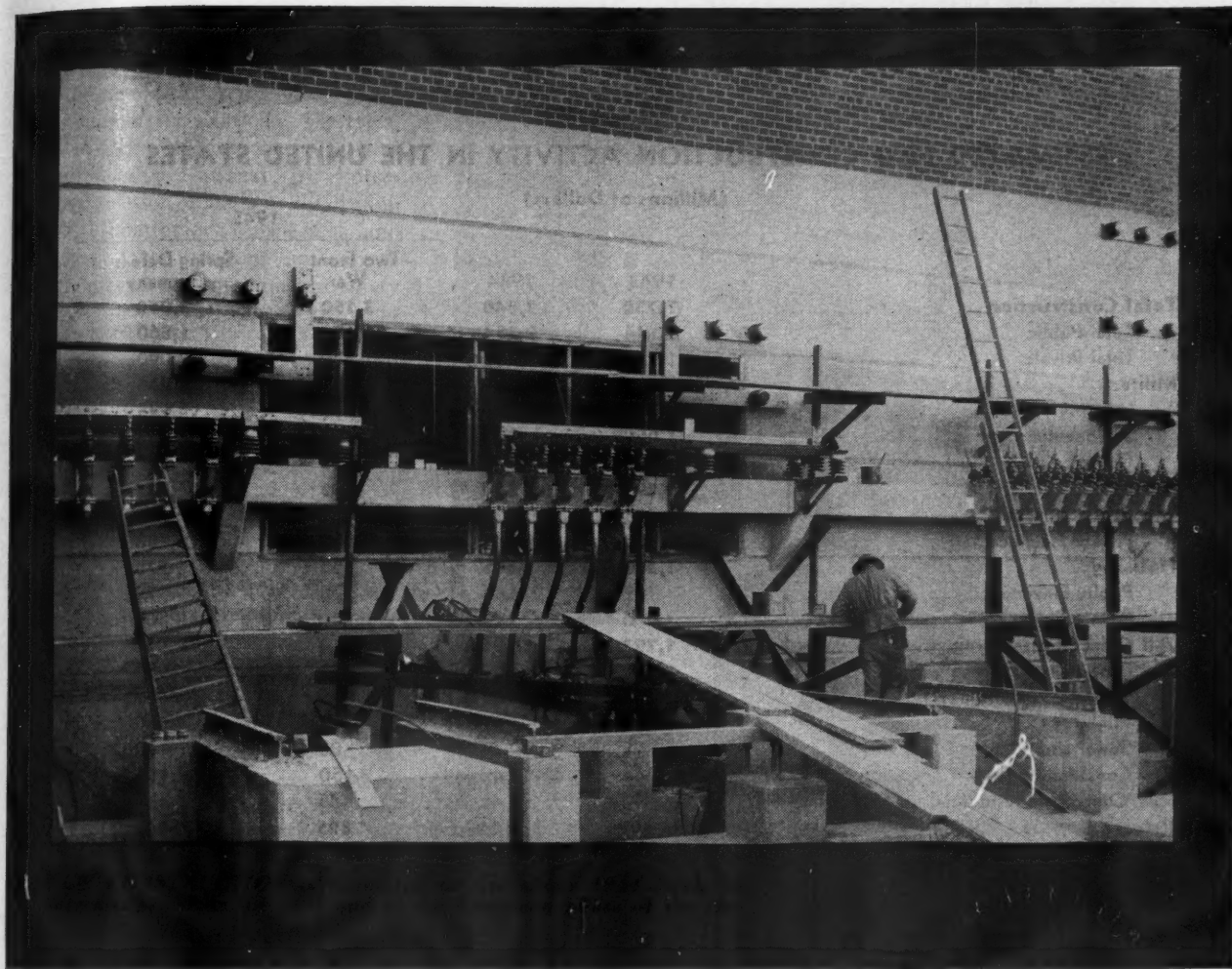
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Forecasting 45

A frank appraisal of the new year, its markets and opportunities, its trends and potentials.

By W. T. Stuart

IN this fourth year of war, the impact of global operations on the economy of the nation is clearly evident. It appears not only in the statistics of industry, the welling pressure on price ceilings and wage levels, but in the individual shops and offices of business men over the country. The capital structure of war which was the mainstay of a large segment of our economy during the conversion and early war years, is pretty well finished. Shortages in manpower—and some materials—stand in the way of an early reconversion or relaxation of construction controls.

The early months of 1945 and possibly well into the summer, like the latter months of '44, will show rock bottom new construction figures, a rising volume of remodeling and rehabilitation work, probably a rapid rise in maintenance and repair, with a continued high level of work in special construction activity, such as shipbuilding, of interest to electrical construction men.

The long continued war limitations, on the other hand, is piling up a backlog of urgent postwar work. Obsolescence, overburdened apparatus, inadequate wiring systems, lack of maintenance

and ordinary wear and tear are taking a toll far beyond the replacement and repair facilities which have been available.

Construction

Estimates of construction potentials in 1945 predict total volume figures approaching the 1944 level. Engineering News-Record estimates an overall construction volume of \$4,200,000,000, Producer's Council, Inc. estimates a somewhat higher figure, 4.8 billions, while unofficial War Production Board estimates slightly under 4 billions. All are in excess of the 1944 volume which will probably be the low spot in the curve. All the above estimates are based, however, on an early end to the European phase of the war. Any long continued campaign in that theater is likely to bring a continuation of the 1944 level or even lower.

Preliminary estimates of the War

TABLE I
ESTIMATED NEW CONSTRUCTION ACTIVITY IN THE UNITED STATES
(Millions of Dollars)

	1943	1944	1945	
			Two Front War	Spring Defeat of Germany
Total Construction	7,732	3,840	3,150	3,950
Total Public.....	6,144	2,354	1,680	1,860
Total Private.....	1,588	1,486	1,470	2,090
Military	2,423	730	480	450
Housing.....	786	222	135	125
Aeronautics.....	1,059	298	195	180
Other Military.....	578	210	150	145
Industrial	2,198	920	595	725
Public Financed.....	1,973	735	400	375
Private Financed.....	225	185	195	350
Housing	1,318	685	525	775
Public Financed.....	702	188	75	75
Private Financed.....	616	497	450	700
All Other Construction	1,793	1,505	1,550	2,000
Public.....	1,046	701	725	960
Community Buildings.....	124	120	125	160
Highways.....	410	318	325	450
Sewer and Water.....	95	79	80	100
Conservation.....	244	142	150	185
Other Non-residential.....	173	42	45	65
Private.....	747	804	825	1,040
Community Buildings.....	96	133	145	200
Farm.....	160	170	195	245
Utilities.....	491	501	485	595

Production Board on new construction during 1944 indicate a volume of \$3,840,000,000 compared with the 3.9 billion programmed for the period back in 1943.

Work financed by public funds accounted for only 61 percent of the 1944 total. In 1942 and 1943 it was approximately 80 percent. Volume in all types of construction was less in 1944 than in 1943. Military construction including troop housing, airfields and storage facilities suffered the greatest decline, from \$2,423,000,000 in 1943 to \$730,000,000 in 1944. The 1943 figure for government financed industrial plants, \$1,973,000,000, also contrasts with the \$735,000,000 total for 1944 in this category.

Remodelling and repair work estimates are not included in the W.P.B. figures but may be considerably higher in 1945 than in 1944. In any relaxation of construction regulations it is likely that an impressive volume of such work will be in process well ahead of new construction activity.

Other Electrical Work

The outlook for electrical construction, installation and maintenance, however, is divorced in many respects

from the more dismal aspects of the construction forecasts. Types of work which are not related to building activity show no apparent decline and in many instances may show substantial increases in volume during the coming months.

Among such continuing projects for 1945 are combat craft and cargo ship wiring. A number of electrical contractors have already developed large ship wiring organizations in cooperation with yards on both coasts and along the Gulf shores. No estimates of electrical work volume in this category are available, but it is unquestionably tremendously large. Programs in ship construction will continue well through the wind-up of the European phase of the war.

Industrial plant wiring and electrical apparatus changes are maintaining a steady volume of work that will continue unabated through to reconversion. Improvements in war material, changes required by shifting theaters of operation, changes dictated by field experience and constant improvements in production methods are all reflected in major alterations to electrical systems which serve the production processes. Many such alterations are also

carried out with one eye on the eventual requirements of reconversion and toward a high degree of flexibility for both accessibility and convenient load shifts.

Motor and apparatus rebuilding and repair continue to climb according to reports from the motor shops. Expanded facilities, production streamlining, new machinery and methods of improvement are still unable to cope with the growing demands under the limitations of dwindling skilled manpower. The 1945 prospects are for a continued increase in this type of work with some hopes of an improved manpower situation.

Trends

Recent removal of restriction of the use of conduit as well as other detailed manufacturing and installation rules originally dictated by shortages of critical materials are part of the pattern of lifting outmoded controls. CMP controls on manufacturing, manpower shortages and project controls through L41 provide strict but flexible supervision and limitation which can be quickly adapted to the wholly different problems of the reconversion period. However, no important relaxation of

overall controls can be expected until after the defeat of Germany.

Revision of the National Electrical Code to come before the Electrical Committee of the National Fire Protection Association this year, will find electrical contractors, inspectors and organized labor seeking an overall tightening and strengthening of safety requirements. Spot checks of what contractors and industrial plant electrical men count as important problems in the immediate postwar era show a considerable number urging a strong, well enforced Code as of first rank importance.

Maintenance is rapidly advancing into a highly organized and planned adjunct to production with emphasis on preventive care. The past year has witnessed much improvement in fluorescent lighting maintenance methods and systematic routines for maintaining designed levels of illumination. Commercial establishments are far behind the industrial plants in care of lighting systems and the year ahead may bring many contractors into this much needed lighting service work.

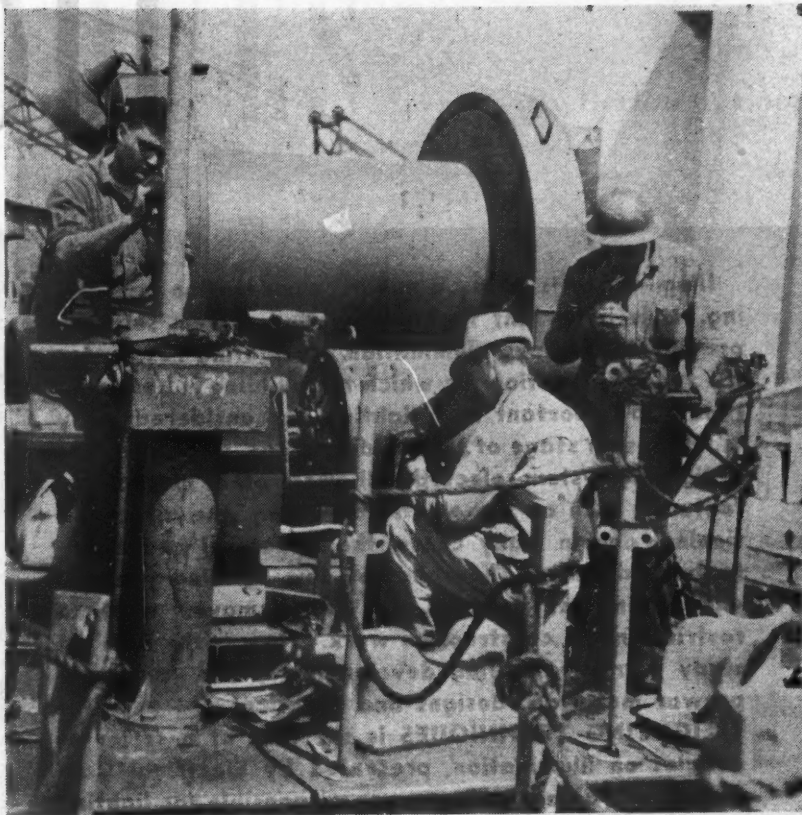
Labor

Among the important developments in the field of labor and labor relations to be expected in 1945 are—

- (1) A vigorous strengthening of apprenticeship programs and standards.
- (2) Educational projects to keep mechanics up to date on war-born apparatus.
- (3) Voluntary annual wage clauses in labor agreements and,
- (4) A probable adoption in some cities of the Joint Industry Board plan which is now operating in New York.

Labor leaders are concerned privately with the dilution of skills in the ranks brought about by urgent wartime manpower requirements. Every effort will be made to raise the average qualifications. The way will be opened for returning service men to enter sound apprenticeship training programs where skills learned in military service can be broadened to meet the needs of peacetime industry.

The impact of electronic developments on the electrical industry and its demand for specialized training has been recognized in the establishment of a course at Marquette University for IBEW men. Intensive training is provided for key men who in turn will carry the "know-how" of electronics back to their home communities for specialization and the training of other mechanics.



SHIP WIRING is expected to continue at present high levels well beyond V-E day.



MAINTENANCE WORK on lighting equipment, wiring, and electrical apparatus will show a substantial increase in 1945 with greater demands for manpower, replacement parts and materials.

LIGHTING

Illumination is today a major consideration in building. It is important that the lighting system selected provide the proper illumination, or lighting result, for the type of function for which the building is designed. It is also important that lighting be considered early in the design stage of the building plans, since the type of lighting system selected will affect other mechanical features, such as the electrical wiring, the air conditioning, and in many cases, the structural and architectural details. Thousands of new building projects will begin just as soon as WPB removes wartime restrictions on construction work. Now is the time to study wartime lighting developments, and to review prewar materials, designs and practices.

LIGHTING TECHNIQUES is the first of a series of articles on illumination, presented by Electrical Contracting as an aid to those men responsible for lighting plans. This article presents some of the more important basic fundamentals of good illumination. In later articles, these fundamentals will be discussed in more detail as they apply to individual lighting problems.

SPOT checks made with architects, engineers and others indicate that there are now thousands of new building and remodeling or modernization projects in the design stage. Practically every one of these require lighting. Men responsible for the lighting plans face a real problem. They have available many light sources, and in a variety of sizes, shapes and colors. They have available many types of materials which may be used in the luminaires, or lighting equipment. These include all types of metals, glass, wood, plastics. They have available a large number of lighting techniques. These include the use of suspended luminaires, which may be any type from totally direct to totally indirect, the use of built-in or flush mounted equipment, cove lighting, coffer lighting, pedestal or wall urn indirect lighting, exposed wall brackets, self-illuminated columns or wall surfaces, and many others.

Because there are so many solutions to any given lighting problem, and because there is probably one solution that has a maximum of advantages over

other solutions, it becomes important that those responsible for the lighting have a thorough understanding of all the lighting tools available and that they work closely with the illuminating engineer. Full use should be made of the type of light source or sources best adapted to the specific lighting problem, as well as of the type of materials available, and of the lighting technique or techniques best adapted for producing the desired decorative effect and illumination result. Otherwise, a lighting system may be obsolete by the time it is installed.

Important factors which must be considered in planning lighting are:

- (1) The lighting result
- (2) Type of light source
- (3) Type of luminaire, or equipment
- (4) Lighting economics
 - (a) First cost of equipment
 - (b) Maintenance and operating cost

Naturally the lighting result desired will vary with the type of building involved and the use that will be made of the building. Industrial plants re-

quire illumination to provide maximum ease of seeing, generally without regard to architectural or decorative effect. However, more and more attention is being given to these factors in industrial buildings. Commercial and office lighting require adequate intensities of illumination, properly shielded and diffused. In most of these installations, decorative harmony between the lighting fixtures and related architectural or decorative treatment is highly desirable. The lighting result for a theatre, auditorium, church, restaurant, ballroom, or similar area may be for relatively low intensities of illumination, but special emphasis is given to the decorative or architectural treatment. In new building projects built in the postwar period, architects will put even more emphasis on combining lighting with architecture. This will be particularly true in buildings designed for general public use, such as theatres, department stores and specialty shops, art museums, churches of certain architectural type, restaurants, cocktail lounges and night clubs, entrance foyers, elevator lobbies and public corridors of public buildings, sales rooms, banquet rooms, and similar public spaces.

Standardized lighting fixtures have an important place in the field of illumination. If they are carefully designed with proper shielding, and if materials are carefully selected to provide a high efficiency and easy maintenance, the consumer will be assured of relatively glare free illumination at a minimum of cost. Since the ultimate in lighting result and decorative harmony can only be achieved, however, through skillful selection of the light source and lighting technique, through expert layout and skilled installation, the architect and designer should be given every assistance in the selection of these to provide the desired illumination through new and unique applications in which the lighting will become part of the architecture.

In planning a lighting system for any project, the lighting result should first be selected. For example, if it is desired to provide a high intensity of well diffused illumination with a minimum of reflected glare, such as might be re-

TECHNIQUES

By Berlon C. Cooper

quired in a general office area, that should be set up as the lighting result to be achieved. Then it becomes a matter of selecting the luminaires or lighting equipment most suitable to the area, space or structural treatment of the room which will provide that result. Color and finish of ceilings, side walls, floors, and furniture should in turn be selected to supplement the lighting equipment in achieving the desired lighting result, as well as in achieving the decorative effect and utilitarian consideration which is desirable.

The subject of the "lighting result" is so broad in scope that it is not practical to discuss it here in detail. It is merely pointed out that a specific "lighting result" is desirable for every application of artificial illumination. If the most appropriate effect and maximum efficiency are to be obtained, it is necessary to consider the architectural treatment and decorative scheme, as well as the type, size and color of the light sources, and type of luminaires, reflectors, or lighting equipment which are to be used. Examples will be given and discussed in detail in the analysis of individual lighting problems in future articles in this series.

Light Sources

Three broad classifications of electric light sources are available for general illumination. Each type has its advantages and disadvantages. These are:

- (1) Incandescent
- (2) Fluorescent
- (3) Mercury vapor

Information on the sizes, shapes, rated operating life, amount of light produced (measured in lumens), cost, construction, operating characteristics, and similar data is readily available from lamp manufacturers or their distributors and dealers. Such data should be obtained and placed on file for ready reference by those responsible for making lighting layouts. Comments here are limited to general information which it is believed will assist in selecting the proper light source for specific lighting applications. If the lighting result selected is to be achieved successfully and economically, consid-

eration should be given to many factors such as; the color quality of the light produced, the rated operating life of the lamp or tube, replacement cost, and efficiency from the standpoint of the light produced (lumens) for the power (watts) consumed. Each light source is discussed separately below.

Incandescent Light Sources

Incandescent lamps in general are considered as point sources of light. The light can therefore be fairly accurately controlled with auxiliary devices such as reflectors, lenses and louvers.

Color Quality of Light Produced: Standard clear and inside frost incandescent lamps produce a light which is in the light yellow band of the spectrum. The lower wattage lamps are less efficient in light output than the higher wattage lamps, and hence are more yellow. The lamps of 25 watt size and smaller are only slightly whiter in appearance than candle light. 1500 watt lamps are comparatively white in color, approaching the color of direct sunlight one hour after sunrise. Intermediate wattage lamps vary between these two extremes in color proportionately with the change in wattage rating. The characteristic yellow of the lower wattage lamps can often be used to advantage in creating certain lighting effects, such as the warmth of sunlight. Lamps rated 500 watts and above are considered to produce light sufficiently white in appearance to provide general illumination of intensities up to 50 foot-candles which is comfortable to the eye, and which mixes fairly well with normal daylight.

Incandescent lamps of sizes from 75 watts up to 1500 watts are also made with a blue glass bulb. These lamps are known as "daylight" lamps since they screen out the predominantly yellow radiation and produce a color quality of light which is an approximation of daylight. Small wattage lamps are available with color coatings and are adaptable for certain decorative color effects.

Rated Operating Life of Lamps: General service type incandescent lamps generally are designed for 750

hours actual operating time for wattages up to and including 150 watts. Higher wattage general service lamps are designed for 1000 hours actual operating time. This length of life has been selected by lamp manufacturers for reasons of operating economies and based on careful studies of the effect of lamp life on the total cost of light. Shorter lamp life increases the cost of maintenance. Longer lamp life produces less light per watt consumed, increasing the number of fixtures required to produce the desired illumination. Lamps for purposes other than general service are available with various rated operating life, to meet special requirements, but as a rule are not used for general illumination.

Replacement Cost: A standard 500 watt general service lamp produces approximately 81,000 lumen hours of light for one cent, based on list price for the lamp and on normal rated operating life. (The term "lumen hour" is used to indicate the amount of light produced by a lamp, measured in lumens, multiplied by the number of hours the lamp is rated to operate.) A standard 1000 watt general service lamp produces approximately 56,000 lumen hours of light for one cent, on the same basis. The lumen hour cost is a fairly good basis for comparing lamp replacement costs of various type lamps. It is pointed out, however, that lamp replacement cost should not be overstressed, since it generally does not exceed ten percent of the overall cost of light. The cost of power (kilowatt-hours) accounts for the major portion of the overall cost of light, particularly where incandescent light sources are used.

Lamp Efficiency: A standard 25 watt inside frost lamp produces approximately ten lumens per watt. A 1000 watt standard service type lamp produces approximately twenty-one lumens per watt. Intermediate wattage lamps are proportionately efficient between these two efficiencies. It therefore becomes immediately apparent that where medium to high intensities of illumination are required, the largest size lamp should be used which is practicable to meet room conditions and natural spac-

[Continued on page 172]



READY FOR LAUNCHING, this craft is in assembly-line position 10 where final check-up on electrical system is made prior to test run.



CREW'S QUARTERS are well lighted, have an electric fan and electric space heaters.

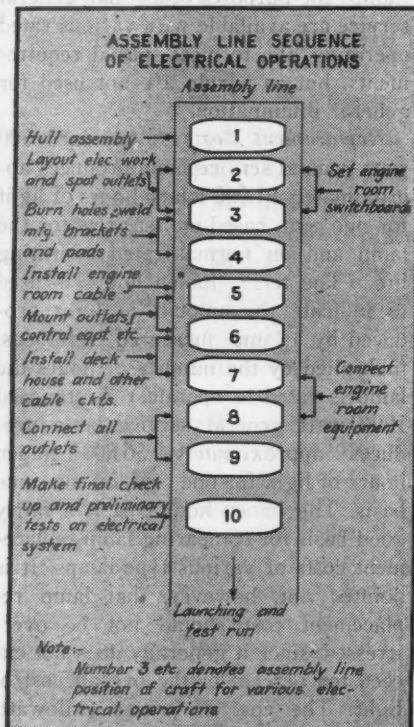


FIG. 1—INSTALLATION SEQUENCE chart indicates assembly-line position of craft at which various types of electrical work are done.

LANDING craft spearhead the establishment of beachheads in this war. These sturdy little craft carry in the first wave of troops with armor, artillery and munitions, then continue to ferry additional troops, food, cargo and other material from the larger LST and cargo ships when they are unable to enter shallow water areas. Invasion successes depend upon the performance of these craft.

WIRING

Electricity plays no small part in the design and operation of these ships—the larger the ship, the more comprehensive and complex is the electrical system. As an illustration, let's consider the LCT (landing craft, tank). Electrical equipment included in the design of these sturdy, allsteel, 115-ft. shallow-draft, ships requires a total connected load of about 32 kilowatts served by two diesel-driven, 10 kw., 125-volt, d.c. generators. The type of load and operation assures a comparatively reasonable demand factor.

Equipment served by the power system includes ventilating; electric space heaters in the various quarters; refrigeration; galley (except a fuel oil burning range); lighting, bilge and fire pumps; radio signaling and riding lights. Crew's quarters are well lighted and equipped with outlets for electric fans and electric space heaters (ranging from 1 to 2 kw. in size). Lighting panels are controlled by automatic door switches equipped with special cutouts for blackout or normal operation. Nested below deck in the compact engine room are the generator control and power distribution panels.

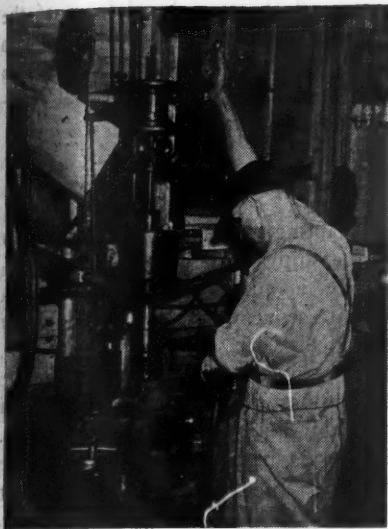
All fused knife switches are equipped with thumb-screw locking devices. Remote controls for most of the equipment are located up in the pilot house.

Marine fittings and cable are used throughout the ship. No steel is drilled except for holes to provide access for conduit kick-pipes and packing glands wherever cable passes through the deck or bulkheads. All cable straps, outlet boxes, and other equipment are mounted with machine screws to brackets or drilled and tapped steel pads which are welded to the steel structure.

Sectionalized Wiring

These craft are so designed that they can be dismantled into three separate sections for ease of transportation to the theatre of operations. There they are again assembled and placed in use. This design also prolongs the combat life of the ship. If one should be hit, the damaged section is removed and replaced by a new section or one salvaged from another unit.

The electrical circuits follow this sectionalized design. At the sectionalization points the circuits are termi-



BOXES ARE DRILLED on a rehabilitated drill press. Vise attachment accommodates various sizes of boxes.



DOOR SWITCH CONTROL and cutout (1 and 2 in photo) are added to deckhouse lighting circuits for blackout and normal operating conditions.

LCT'S

By August Eckel

nated in weatherproof receptacles mounted to the bulkheads in the narrow passageway between the aft and forward deckhouses on both the port and starboard sides of the ship. Heavy duty, rubber insulated cord with plugs are used to maintain circuit continuity when the sections are reassembled. Cords are strapped to the underside of the steel bridge above the deckhouses. As illustrated in the accompanying photo such circuits include call bell, winch, side lights, heaters, ignition, lighting and phones. Both the cords and the outlets are equipped with identifying metal nameplates.

How, with hundreds of these craft being launched monthly throughout the nation's shipyards, could the electrical installation keep pace with the speeded-up production schedule? Anyone familiar with Navy specifications and inspection knows that everything must be up to par—an important qualification with human lives and the success of military missions depending upon the performance of the craft. One answer to the problem was found down in a Memphis, Tennessee shipyard.

Back in 1942, the Pidgeon-Thomas



SHOP FABRICATION of special cable straps (400 per ship) keeps two mechanics busy.



CORD PREFABRICATION for sectionalized circuits, electric heaters, etc., is done in this section of the field shop.



WIRING SUPERVISORS (L to R) Navy Inspection Officer, L. L. Garrett, Chief Machinist, U.S.N.; Tri-State electrical superintendent Jack Liles and manager L. H. Lanahan, consult a deck plan.

Iron Company, structural steel fabricators, offered its services to the U. S. Navy and secured a contract to build LCT craft. When it came to the electrical installation, the company handed the problem over to Tri-State Armature & Electrical Works, Memphis electrical contractor and motor service shop, who had done their electrical work for years. Since Tri-State had never before wired a boat it, too, started from scratch. Being in this particular electrical field, Tri-State's manager, L. H. Lanahan, knew the importance of speed and service. He had some very definite ideas about mass production installation techniques and proceeded to adapt them to the shipbuilder's assembly line.

Organization Was First Job

After fabricating the hulls in sections at their inland plant, Pidgeon-Thomas trucked them to an unused steel warehouse at the river's edge where the craft were assembled. Starting at one end of the long building, each ship gradually took shape and received additional equipment until at the end of the line it was complete and ready for launching and test runs. Harry Lanahan's problem was to so coordinate the electrical installation with the ship assembly that his crew, too, was ready for their test work when the ship hit the water. Reduced to basic considerations, the problem was one of pure organization involving the prefabrication of material and the use of specialized installation crews.

Full credit for the success of the straight-line production system for the electrical installation goes to Tri-

State's field supervisor Jack Liles and his two assistants Adolph Richter and George McClintock. On their shoulders rested the responsibility of actually organizing and training the field crews and making the necessary day-to-day adjustments to attain top-speed progress.

The all-important problem of material procurement was solved by Lt. G. R. Faust, Supervisor of Ships, in charge of the program for the Navy. Through his cooperation, all phases of the construction program were coordinated and materials kept flowing regularly to eliminate delays. With the aid of motorized equipment the shop crew of nine to ten electricians drilled and tapped outlet boxes, silver-soldered nipples to them; made up kick-pipes and packing glands; made special cable straps, connector cord sets, special jigs and tools; and in general performed all the chores that did not actually have to be done on board ship. Working in conjunction with this shop crew was a two-man cable make-up crew whose sole job was to measure, cut and tag the marine cable circuits. With the aid of a simple, yet comprehensive, identification system denoting type and size of cable, length, circuit and terminal designations and installation locations, these "pre-fab" crews were able to keep the ship installation crews supplied with plenty of materials.

Once the material pre-fabrication was under way, the field installation crews were organized. Each specialized group had its designated job to do. Where it ended, another took over and so on down the line. Installation work was carefully scheduled to avoid conflict between the various trades.

Figure 2 shows a breakdown of the complete electrical organization into the component crews; Fig. 3 gives an approximation of the electrical materials installed on each ship.

Installation Sequence

Adapting the field installation crew to the shipyard assembly line was primarily a question of formulating a definite sequence for the installation of electrical work. Once this was done, keeping pace was no problem. Figure 1 outlines the general sequence of assembly-line electrical operations. Numerals in the diagram denote the various "Positions" along the line at which the different crews operate. Sufficient overlap between positions was provided to add flexibility.

The first electrical work begins at Positions 2 and 3, after the hull has been assembled. Here the engine-room crew of nine men gets first crack below decks before the superstructures are added. They install the generator and distribution panels; controls for generators, fire pump motors, fans and other heavy equipment. Simultaneously, a lay-out crew of four makes the necessary measurements and spots all holes and outlets—following through on the superstructures immediately they are placed in position. Wherever possible, templates are used to increase accuracy and speed this work. Right on the heels of the layout crew are two check-up men who go over the layout.

Starting in Position 3 and carrying over to Position 4 is a crew of four welders and three electricians who burn all the necessary openings for cable and conduits and weld all the mounting pads and brackets for straps, clamps, outlet boxes and panels. While an engine-room cable-crew of seven electricians goes below deck in Position 5 to install cable, and 11-man deck and pilot house crew starts to mount all outlet boxes and control equipment and follows through with the installation of all cable in Positions 6 and 7.

By the time Position 8 is reached, all electrical connections below deck are completed and the deck crew begins to connect all outlets—a job that has to be completed at Position 9 so a final check-up can be made before system tests are made in Position 10. Here a 3-man test crew takes over and puts the electrical system through its paces. This includes paralleling of the generators and a four-hour full load test of the equipment. Communications circuits are installed along the line by a 4-man crew—two on the

radio and two on the speaking tube.

A night shift of eleven electricians takes over at the end of the day. Nine of them work on the ships doing mostly check-up work and the inevitable "odds and ends" to have everything in readiness for the day crew when it reports in force in the morning. The other two men devote their time to general maintenance around the yard.

Entirely divorced from the ship wiring is a day shift of seven electricians whose sole job is the handling of electrical maintenance throughout the shipyard. This involves such items as power and lighting circuits, electric welders, floodlighting for night work, relamping, and hundreds of other small chores. Upon them rests the responsibility of keeping the yard in continuous operation from the standpoint of electrical service.

All heavy equipment is distributed to the ships by an overhead bridge crane which spans the width and operates the entire length of the building. Wiring material is delivered in quantity to the ship Position according to

the type of installation work to be done.

To keep the installation crews from lagging because of the lack of a certain piece of equipment—and this sometimes happens with the best of plans—a "runner" operates between the assembly line and the field shop. Because of the well established identification system, an electrician need ask for a specific length of cable, a box or panel or other equipment by number only. The "runner" immediately gets the item from the field fabrication shop. The general plan is to have each ship position well supplied with the required materials at all times.

On the surface this may appear to be a somewhat complicated set-up. It really is not. It is nothing more than a breakdown of an over-all job into the component parts and the training of specialized crews to handle each part—the basic foundation of mass production, assembly-line methods. Also, from the standpoint of the skilled labor shortage it was an intelligent approach. Men who never before handled a piece of electrical equipment

are now working, under permit cards, on this ship wiring project. Although many of them probably could not handle a complete electrical installation from start to finish, they have applied their specialized training to their specific tasks and are doing a commendable job. The 192 ships that Tri-State have wired under this plan and the coveted Army-Navy "E" award pins that Pidgeon-Thomas and Tri-State employees proudly wear are evidence of its success.

It required considerable thought, study, planning and patience. Wholehearted cooperation of the electrical contractor's, shipbuilder's and Navy personnel at the yards resulted in a drastic reduction in ship wiring time and an increase in the ship launching schedule. This is another page in the growing chronicle of the electrical contractor's wartime achievements—another testimony to his versatility and ability to efficiently handle production work; to adequately plan and organize his staff and operations to fit the job at hand.

FIG. 2

BREAKDOWN OF SPECIALIZED ELECTRICAL CREWS

Type of Crew	Number of Men	Ship Position
SHOP CREW	10	Field Shop
Drilling and Tapping Boxes — 1		
Fabricating Cable Straps — 2		
Fabricating Back-Bars — 2		
Silver-Soldering and Painting — 2		
Elec. Cord Make-up — 2		
Jigs and Tools — 1		
MARINE CABLE MAKE-UP	2	Cable Warehouse
SHIP CREWS		
Engine Room — Install Equipment	9	2 and 3
Electrical Layout	4	2 and 3
Check-Up — Layout	2	2 and 3
Burning and Welding — Holes and Mounting Pads	7	3 and 4
Engine Room — Wiring	7	
— Install Cable		5 and 6
— Make All Connections		7 and 8
Deckhouse — Wiring	11	
— Mount Outlets		5 and 6
— Install Cable		6 and 7
— Make All Connections		8 and 9
Radio and Speaking Tube	4	6 to 9
Final Check-up and Test	3	10 and after launching
Night Shift — primarily check-up work	11	All positions (2 men on maintenance)
YARD ELECTRICAL MAINTENANCE — Day	7	Entire shipyard

FIG. 3

ELECTRICAL EQUIPMENT INSTALLED ON A SINGLE SHIP (Approximate Quantities)

Quantity	Type of Equipment
6,000 Feet	Marine Cable of various types and sizes — cut to definite circuit lengths and tagged.
439 Feet	Packing material for kick-pipes and packing glands where cable passes through bulkheads.
2½ Lbs.	Weatherproof sealing compound
112	Marine type outlet boxes for lights, junctions, receptacles, connection blocks, etc.
10	Marine type fuse panels (5-with switches, 5-without switches).
4	Vent fan starters.
7	Marine type telephone outlets
6	Electric space heaters (1 and 2 kw. size).
38	Lights.
1	Bilge and fire pump starters
2	10 kw., 125-volt, d.c. generators.
1	Generator control panel.
1	Power and light distribution panel.
400	Cable straps — assorted sizes, factory made.
400	Cable straps and brackets — made in field shop.
300	Holes drilled in outlet boxes and terminal nipples silver-soldered to them.
186	Terminal tubes — soldered in field shop.
24	Nipples silver-soldered in field shop.
72	Conduit kick-pipes — about 12-inches long — made in field shop.

Annual Wage—POLITICS

NOW that the United States Government has expressed willingness to study officially the annual wage as a device for raising the standard of living; now that a number of large employers have privately stated their willingness to pass to the use of this device, it is well to look at a few of the practical problems involved in adopting the annual wage.

The annual wage was first mentioned seriously as a program for labor in 1936. So swift have been events, and so rapid have been changes of attitude on the part of business and Government since 1936, that it may be said that what began as a program, with definite political and ideological aspects, has now developed into an engineering project. When the annual wage was first seriously brought forward as an expedient, the United States was still in the midst of a great depression. The annual wage looked, therefore, like a proposal from labor to get more out of national annual income than it deserved. This was so stated in some directions. Moreover, those departments in the Government most closely concerned with the problem were talking at that time in terms of applying an insurance principle to underwrite and guarantee the annual wage. The building trades were especially singled out as a point where the new proposal could be experimented with and applied. Unemployment was viewed as a disaster which was to be alleviated by the insurance principle, just as fires, hurricanes, droughts have been offset—by the collection of premiums and the pooling of funds and the payment of losses. No definite formula, however, was developed and no practical program was brought forward to implement the annual wage proposal.

In 1936 the United States was still under the spell of classical economy. The great depression was being viewed as one of those periodic falls in business activity, more extreme perhaps than usual, but still part and parcel of a system which had always known periodic rises and falls of business. The wage theory was still under the domination of what has frequently been called the iron law of wages; that is,

Labor likes the annual wage. Here is their viewpoint on this important issue.

By M. H. Hedges

*Director of Research
I.B.E.W.*

that there is just so much money available for wages and no more.

Bill Jones, mechanic, could make just so much for his services and no more in the economic system of which he found himself a part. In this system Bill Jones found that the best he could do, say, in building construction, was about 200 days a year if he were lucky, and frequently his working year dwindled to 80 and 100 days.

Bill Jones, when he was an electrical worker actually earned in certain recent years the following estimated annual income:

*Estimated Annual Income of
Construction Electrical Workers
1931-1943*

<i>Year</i>	<i>Average Annual Income</i>
1931	\$1,007
1932	634
1933	541
1934	696
1935	989
1936	1,570
1937	1,846
1938	1,537
1939	1,650
1940	1,900
1941	2,623
1942	3,280*
1943	3,071

* Calculated on the basis of 2,080 hours at straight time (\$2,995) plus 131.8 hours at time-and-one-half (\$285). This is probably an understatement, as much of the overtime work in 1942 was at double-time.

Under the spell of classical economy there seemed no real egress from this deadly round of lowered income concomitant with increased production under the impetus of a dynamic technology.

In the field of the annual wage, con-

temporary historians may well point out that one has an example of the swift course of historical events which makes back-numbers of everyone who does not zealously follow forces that are shaping lives. In 1945 when the annual wage is now mentioned, it does not fall upon our ears with the same sinister sound, simply because new plans are being developed for the American economic system. This does not mean at all that the annual wage program is labor's exclusively. Business men have contributed ideas to the new economy being developed, which makes the annual wage, if not a necessity, a logical consequence. The annual wage, therefore, passes out of the realm of ideologies and politics into the realm of engineering.

Can Be Attained

Yes, full employment can be attained. Full employment cannot be attained, however, without definite aims and standards and without team-play and cooperation.

First, the goal of full employment must be adhered to. No substitute of something "about as good" will accomplish the desired end. High employment or full production are not equivalents of full employment. Under mass production and machine technology, it is possible to have full production and a constant residue of five or six million unemployed. However, though sharp difference of opinion arises over the general concepts, it is likely that numerically full employment after the war will be fixed near 55 to 60 million men.

Second, full employment cannot be attained in a static economy. The key to success here is a continuous flow of

S OR ENGINEERING?

money from the point of origin, of savings, into production and wages, and the flow of goods out of production into distribution. Idle money is a menace to a dynamic economy. Savings, whereas salutary for the individual, are a clog and obstruction to an economy destined to attain full employment.

Encouragement lies in the present war economy. For a few years the national annual income has more than doubled, from 70 billion dollars in 1939 to 148 billion dollars in 1943. Production has reached an all-time peak. Virtually no workers are idle. Moreover, many new workers have entered the production arena—thousands of women, younger workers and older workers have swelled the ranks of industry. If such conditions are possible

in time of war, they are attainable in time of peace.

Savings in a 150-billion dollar economy attain the colossal figure of approximately 30 billion dollars a year. These cannot be put to the use of production without orderly processes, stable agencies, and machine-like cooperation.

Full employment does not mean

- (1) Regimentation, the control of workers by employment offices, or government commissions.
- (2) Undisciplined production and distribution. A nice balance must be attained in national fiscal policy, production and distribution.

However successful the United States of America may be—as it is today in attaining full employment,

there will always be a lag between complete employment and disemployment of workers. Disemployed workers must be ballasted by a universal social security program, which must give pensions, jobless benefits, disability benefits, and health care. No social security program works in an economy where widespread unemployment exists.

Full employment puts the human element in the nation ahead of mere material property.

Inasmuch as attainment of full employment involves a huge degree of production, the expenditure of energy in wasteful internal conflicts must be regarded as a serious impediment to success. The present policy of labor-management cooperation should be continued.

[Continued on Page 168]

TEN - YEAR RECORD OF EMPLOYMENT I.B.E.W. MEMBERS IN THE CONSTRUCTION INDUSTRY

1934 - 1943

FULL-TIME EMPLOYMENT EQUALS
2080 MAN-HOURS PER YEAR

ANNUAL MAN-HOURS
PER WORKER

2500

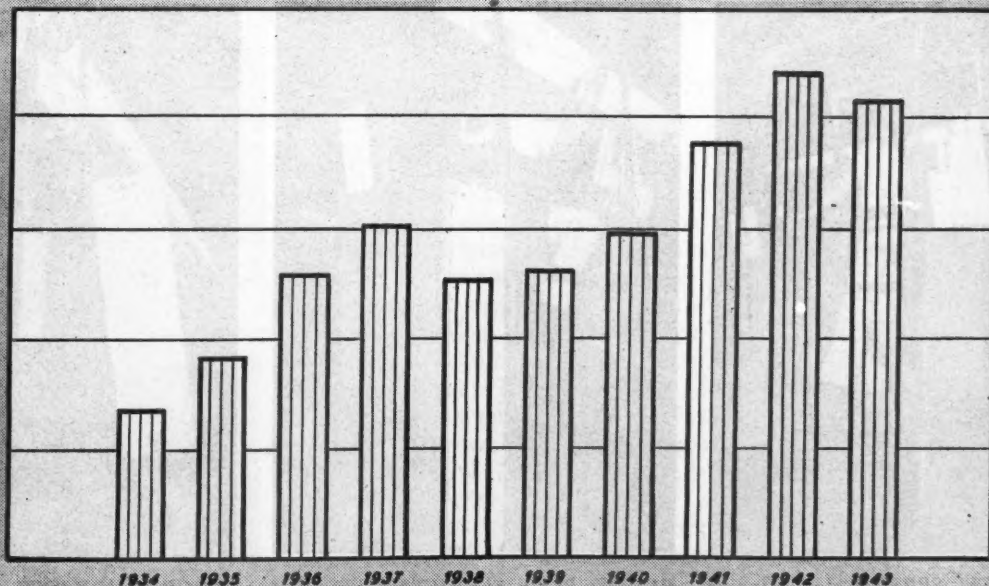
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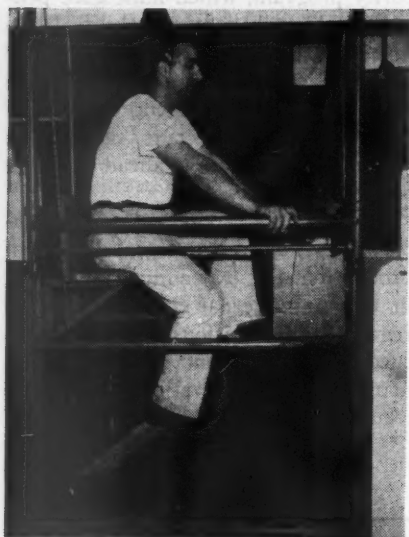
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RESEARCH DEPARTMENT
INT'L BRO. OF ELEC. WKRS.

Mono-Rail Trolley for

Lighting maintenance given primary consideration both in original plant construction and in the plant engineering procedure of machinery location to allow passage of fluorescent buggy.



SERVICEMAN PEDALS merrily along down the 500 foot mono-rail to a defective unit on a spot-call. Lift trucks carry the buggy to any convenient point in the row in which there is a bad unit. Photograph below shows buggy being lifted.

MAINTENANCE of the extensive lighting system at Remington-Rand's propeller plant in Binghamton, New York, is given second consideration only to production requirements in C. H. Crawford's (plant engineer) plant layout schedules. Machinery is given a location tolerance sufficient to permit passage of the fluorescent maintenance buggy. Designed after the fashion of an under-slung crane cab, the buggy is pedalled like a bicycle along the 500 foot mono-rails. Complete fixture servicing is only a matter of a few minutes; travel and positioning time between fixtures only a few seconds.

The procedure is the result of vision and foresight on the part of Colus C. Hunter, Remington-Rand's consulting engineer at Elmira, New York. Mr. Hunter, a great proponent of better industrial lighting, foresaw complications in maintaining the designed lighting levels if adequate provisions were not made. Consequently, he designed the mono-rail fixture support,

shown in the accompanying illustration, to carry the specially constructed buggy along the 65 rows of 500 foot continuous-strip fluorescent lighting.

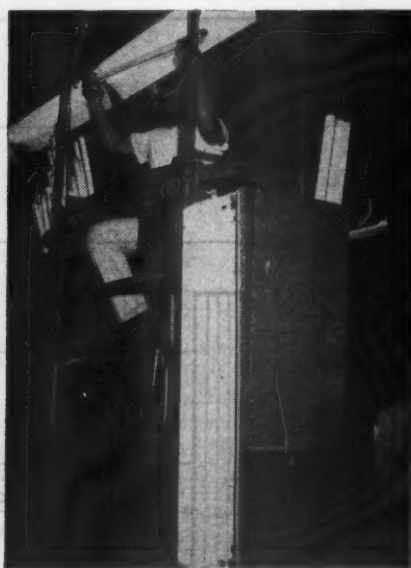
Wiring Design

The plant is constructed entirely of wood, and the electrical design employs 4160 volt distribution to load centers. High-voltage capacitor banks of 120 kva. at each unit substation maintains high power factor. Five hundred kva. transformers equipped with network protectors supply 120/208 v. power directly to the four-conductor networked bus-duct. (*Electrical Contracting*, November, 1944).

The unit substations are mounted in the structural area between the vaulted roof and the building chords. Lighting panels, supplied directly from plug-in bus-duct switches (three pole-solid neutral) are mounted on the side-rail of the catwalk for easy and quick accessibility. The panels are four wire, 42 circuit with non-fusible



TOP-MEMBER SPREAD for slipping trolley wheels past reflector edges. Locking mechanism holds wheels to rail.



BUGGY PUTS SERVICEMAN in easy working position. Complete servicing can be accomplished in several minutes.



FLOOR MAN PASSES up clean reflector to replace dirty one. Note locking mechanism and hinging of top member.

or Fluorescent Maintenance

By

Robert E. Miller

reset circuit-breaker type branch switches. Each panel is fed through a 200 ampere magnetic breaker, mounted in the panel and controlled by push-button from the floor. The seven fixtures per circuit are located in such an arrangement as to minimize stroboscopic effect. Since each panel is three phase, the branch circuits are easily interlaced so that consecutive fixtures feed progressively on a fixed pattern of phase rotation.

Fixtures are three-tube units using 40 watt white lamps. The mounting height is 15 feet and center distances between the 65 continuous rows of 103 fixtures each running the width of the plant are 15 feet.

Maintaining Specified Levels

Initial foot-candle meter readings gave 48 foot-candles at the working plane (approximately 40 inches above the floor). Experience data reveals that after 3000 hours continuous burning an average of 30 foot-candles is



FLUORESCENT LINES five hundred feet long mounted 15 feet high on 15 foot centers. Fixtures are fastened beneath mono-rail which carries maintenance buggy. Group replacement is made on scheduled basis.

still available. This level varies slightly throughout the plant depending upon the particular area, but not enough to warrant special consideration in the maintenance schedule.

A group replacement schedule is systematically executed on a 3000 hour basis. At that time the reflectors are washed, and tubes and starters both replaced. Connections and sockets are carefully checked and ballasts are inspected. Ballasts showing any sign of deterioration whatsoever are also replaced. This practice is based on experience data compiled from the very beginning.

Ballast Replacement

No-blink type starters were (at time of writing) unobtainable and regular starters were used which would not remove deactivated lamps from the line. The continuous attempt at re-starting these lamps over-loaded the ballasts until they finally burned out. The consequent high mortality rate of ballasts resulted in thorough inspection at time of relamping, and replacement if any sign of overheating was apparent. This procedure reduced call-backs to a considerable extent.

The maintenance buggy frame-work is constructed of welded inch-and-three-quarter cold drawn tubing. The four corner-risers are hinged to permit sufficient spread (about 19 inches) of

the trolley wheels to pass by the reflector edges. A chain and sprocket plus a locking system of eccentric levers, permits the buggy operator to lock his carriage to the mono-rail. The buggy is lifted at any convenient aisle by a platform lift truck to the proper fluorescent line. In the case of a "spot-call" the serviceman pedals down the line to the faulty unit. In carrying out the group schedule, he starts at one end and proceeds to the other.

Two men handle a line of 103 fixtures per eight hour day plus a small number of spot-calls each day. One serviceman operates the buggy which carries a number of bins for new and defective parts such as starters, ballasts, sockets, etc. Two tube-bins, one fore and one aft, carry the new tubes and provide space for the used ones. The ground man supplies clean reflectors to replace the dirty ones removed.

New lamps and clean reflectors bring lighting levels back up to 48-foot-candles average.

C. L. Wagener, chief electrician, commenting on the economy of his fluorescent maintenance operations, expects to reduce his expenditure still more when no-blink type starters are again available. It is hoped that ballast mortality can then be appreciably reduced or even entirely eliminated, likewise eliminating expensive spot-calls between routine service schedules.



MONO-RAIL is carried by trusses on ten foot center. Flexible conduit carries branch circuits through center of rails.

Estimating BRANCH CIRCUIT

Such layout variables as number of and distance between outlets and wires per conduit influence wire installation labor. Here is a set of units that take these into consideration.

TABLE 1
BRANCH CIRCUIT WIRING INSTALLATION
Man-hours Per 1,000 ft.

Average Distance Between outlets (in feet)	NO. 14 WIRE Average No. of Wires Per Conduit			
	2-2.5	2.5-3.5	3.5-4.5	Over 4.5
1- 2	9.0	8.0	7.5	6.5
3- 5	8.5	7.5	7.0	6.0
6-10	7.5	7.0	6.5	5.5
11-15	6.5	6.0	5.5	4.5
16-20	6.0	5.5	5.0	4.0
21-30	5.5	5.0	4.5	3.5
Over 30	5.0	4.5	4.0	3.0

NO. 12 WIRE				
1- 2	10.0	9.0	8.5	8.0
3- 5	9.0	8.0	8.0	7.5
6-10	8.0	7.5	7.0	6.5
11-15	7.0	6.5	6.0	5.5
16-20	6.5	6.0	5.5	5.0
21-30	6.0	5.5	5.0	4.5
Over 30	5.5	5.0	4.5	4.0

NO. 10 WIRE				
Average Home Run (in feet)				
20-30	9.0	8.5	8.0	7.5
31-50	8.5	8.0	7.5	7.0
51-75	8.0	7.5	7.0	6.5
Over 75	7.5	7.0	6.5	6.0

NO. 8 WIRE				
20-30	10.0	9.5	9.0	8.5
31-50	9.5	9.0	8.5	8.0
51-75	9.0	8.5	8.0	7.5
Over 75	8.5	8.0	7.5	7.0

Notes:

For working heights over 12-ft. above floor—add 5% to units for each additional foot of height.
For wire laid in trough or wireway—use the 1' to 2' units.
Units do not include labor for splices, connectors, etc.

Formulas:

- (1) Avg. distance between outlets = $\frac{\text{Total branch circuit conduit (in feet)}}{\text{Total number of outlets}}$
(2) Avg. number of wires per conduit = $\frac{\text{Total branch circuit wire (in feet)}}{\text{Total branch circuit conduit (in feet)}}$

THE labor required to install branch circuit wiring varies, as in the case of conduit work, with the length of straight runs or "clear pulls" and the number of outlets per conduit run. Another important variable enters into the wire pulling labor—that of the number of wires per conduit. Every contractor is aware of the fact that as the number of wires per conduit increases, the man-hour unit per foot of wire decreases. For example, it would take considerably more labor per wire foot to pull in two branch-circuit conductors in a 25-ft. run of conduit than it would to pull in five or six wires simultaneously, provided, of course, that the N.E.C. conduit-area rules were observed. A simple mental calculation will show that the labor per foot of conductor is much lower in the case of the multiple-conductor pull.

When using this premise—the more conductors per conduit and the longer

TABLE 2
"TRIM" LABOR FOR OUTLETS

Type of Outlet	Man-hours, Each
Ceiling Outlet	.05
Bracket Outlet	.05
S.P. Switch Outlet	.12
Duplex Receptacle	.12
Clock Hanger	.12
Fan Hanger	.12
Floor Receptacle Outlet	.15
3-Way Switch Outlet	.22
4-Way Switch Outlet	.22

Note:

These units are included in the "Conduit outlet" table units and are not used in estimating a job. They are presented here for use only as a quick check of the project upon completion of the "roughing" portion to compare the job status with the original estimate.

WIRING

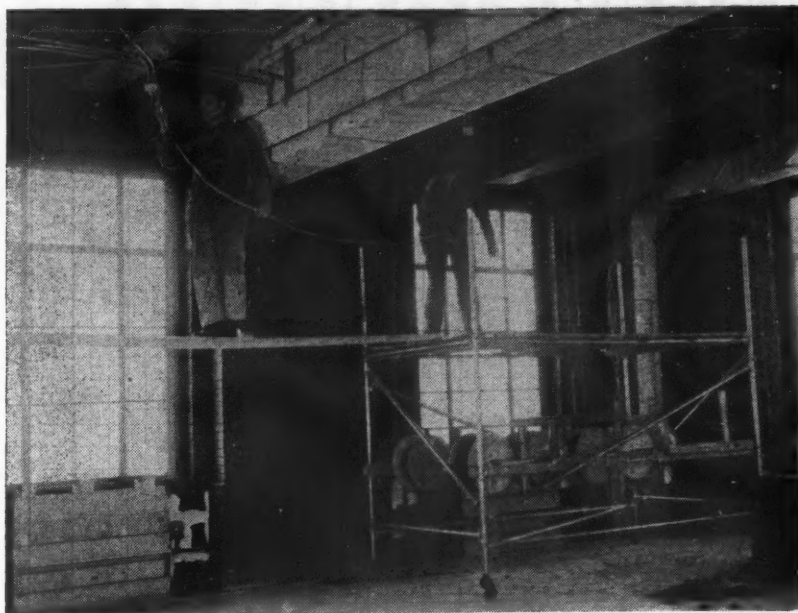
By Leo W. Witz

Continental Electrical Construction Co.
Chicago, Illinois

the uninterrupted conduit run, the lower the man-hour labor unit per foot of conductor installed—it is necessary to use tables based on a "straight run" or "straight pull." You will recall that in the two previous articles on conduit installations appearing in *Electrical Contracting* (August 1944, pages 43-46; Sept. 1944, pages 48-52) the basic man-hour tables were developed on "straight-run" conditions. Such deviations as cuts, bends, threads, fastening to outlet boxes, etc., were considered under separate "outlet" units. These units in the "separate outlet" tables also include such wiring labor as splices, taps, and connection to wiring device; thus maintaining the outlet as a completely installed unit. For example, the conduit outlet unit for duplex receptacle outlets includes such labor items as cutting, skinning, and connecting the two branch circuit wires to the receptacle; for a ceiling outlet it includes cutting and skinning the two extended wires, making average splices and completing the outlet work exclusive of hanging the fixture.

To maintain an estimating system that is consistent throughout its various phases—and that is the only type of system to use—wiring units for "straight pulls" and "special conditions" must be developed and used. Table 1 which accompanies this article is based on "straight pulls". Splices and connections, as mentioned before, are covered in the "conduit outlet" tables in previous issues. The effective use of this table—like any labor unit—depends upon an accurate material "take-off."

To simplify estimating, the units in Table 1 are based upon the installation of a given lineal quantity of wire in conduit at a given man-hour unit per



ROLLING SCAFFOLD with multiple wire reel rack speeds up branch circuit wiring in large open areas. One reel set-up is all that is required for multiple conductor circuits.

**ELECTRICAL
CONTRACTORS AND ENGINEERS**

SCHEDULE SHEET

FORM 1

JOB _____ ESTIMATE NO. _____
 ADDRESS _____ SHEET NO. _____
 SYSTEM _____ OF _____ SHEETS
 EST. BY _____ SCALE _____ DATE _____

KINDS OF MATERIALS

Outlet Trim Labor

QUANTITY

LABOR

UNIT EXTENSION

Man-Hours

Man-Hours

SAMPLE CHECK ESTIMATE

**FLAT SLAB JOB - Branch Circuits
From Panel "A"**

Ceiling Outlets	2	10	05	12	33	1	3	86
S.P. Switch Outlets	1	56	12	13	55	7	18	
3-Way Switch Outlets		88	22	4	65	2	60	
Duplex Receptacles	1	20	12	10	55	5	50	
Bracket Outlets		20	05	4	40	1	60	
1/2" EMT Conduit				720'	2.4 C	1	7	28
3/4" EMT Conduit				180'	3.0 C	5	40	
#12 E.C. Wire				3000'	6.5 W	1	9	50
1/2" EMT Couplings				72				
1/2" EMT Connectors				120				
3/4" EMT Couplings				18				
3/4" EMT Connectors				30				
Misc. (straps, solder, etc.)								

Units in this column
from Table 2.

EST. HOURS TO "TRIM" OUTLETS - 5.94 EST. TOTAL HOURS - 72.89

To Check Job Labor Status:

Labor used to "rough-in"
conduit and outlets (hours) — 40.0 (actual)

Hours to Complete Outlets - 5.94 (estimated)

Hours to pull wire - 19.90 (estimated)

Total hours for "Trim" Work 25.44

TOTAL hours for complete job 65.44 (based on present status)

Thus the job, at present status, appears to be 7.5 man-hours under the estimated labor.

FIG. 1—SAMPLE CHECK ESTIMATE made to determine labor required to finish a job. Units from Table 2 (for check purposes only) are used to determine "outlet trim" labor. In preparing the original estimate this "trim" labor was included in the "conduit" table of labor items (*Electrical Contracting*, August 1944, page 44).

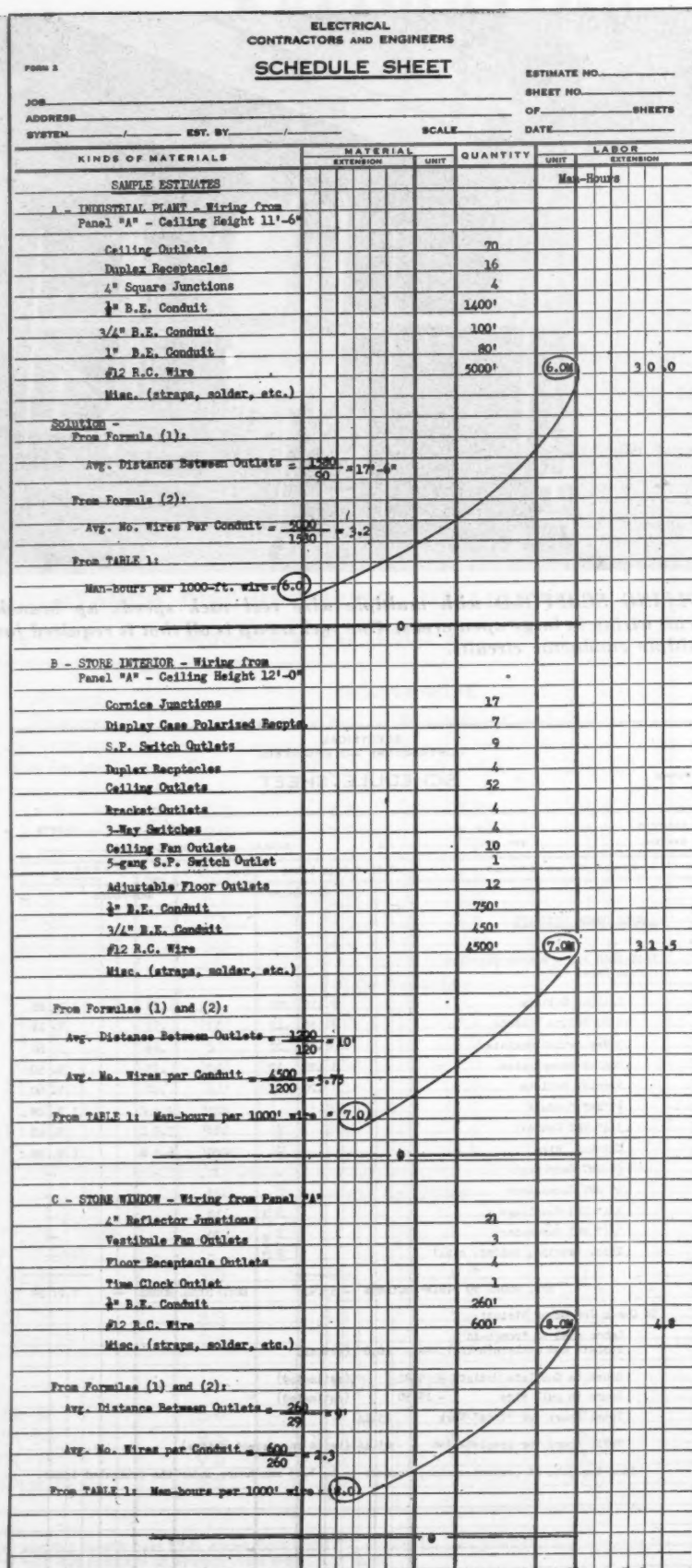


FIG. 2—SAMPLE ESTIMATES illustrating the use of formulas in determining the proper labor unit to apply to the branch circuit wiring. Note how labor is influenced by variance in distance between outlets and number of wires per conduit in the three estimates.

1000 feet of wire. Conductor sizes under consideration for branch circuiting range from No. 14 through No. 8. Generally, wiring between outlets will be either No. 14 or No. 12; home runs may be No. 10 or No. 8, depending upon the amount of copper needed to maintain good operating voltage at the outlet (consideration of voltage drop). In addition to the number of outlets per conduit run, the spacing of these outlets, and the average number of conductors per conduit, ceiling height will materially affect the wire installation labor. In general, the same percentages can be applied to the wiring tables as are indicated in the conduit tables (previous issues) for increased working heights.

It is important to establish units which the estimator, after making an accurate appraisal of the average job condition, can apply; or permit him to isolate special portions of the job and apply different units. The attendant Table 1, based on average quantity and average length ratios, does just that. The estimator can make a more accurate estimate of actual wire installation labor than if he were to apply a single man-hour per foot unit to the total wire take-off quantity (many hundreds of feet of which may be installed as multiple wires in single conduit runs) on various jobs.

Use of Table

To use Table 1 it is necessary to determine two quantities: The average distance between outlets in the conduit run; and the average number of wires per conduit. The following simple formulas are used:

Average distance between outlets (in feet) equals the total branch circuit conduit (in feet) divided by the total number of outlets.

Average number of wires per conduit equals the total branch circuit wire (in feet) divided by the total branch circuit conduit (in feet).

Knowing these two quantities the estimator finds the horizontal line in the proper wire size bracket of Table 1 corresponding to the "average distance between outlets" and goes along it until he is in the column corresponding to the "average number of wires per conduit". The labor unit at this point is the proper "man-hours per 1000 feet" to use for determining his wire installation labor cost.

Sample estimates "A", "B", and "C" (Fig. 2) illustrate the use of Table 1 in estimating wire installation labor.

[Continued on page 103]

Infra-Red DEHYDRATION

Lamps and air blast dry shredded salted cod in continuous operation.

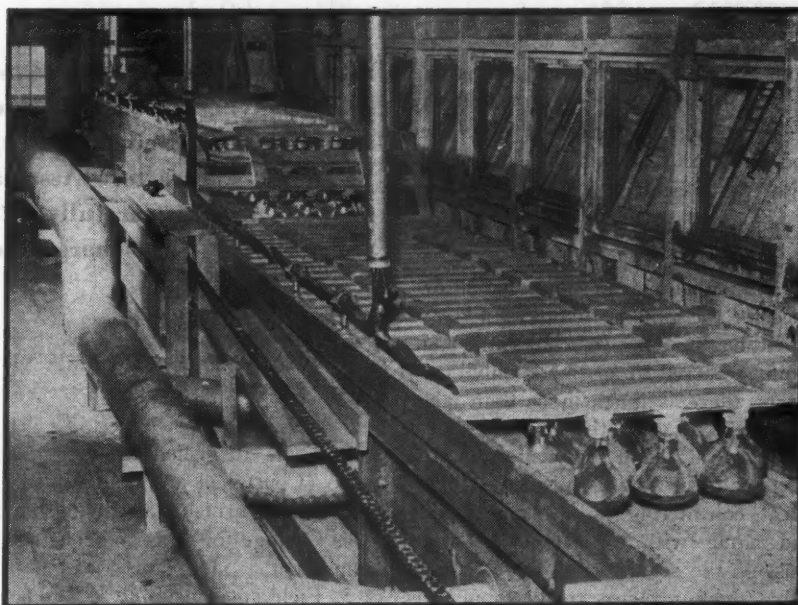
By L. V. Burton,
Editor of "Food Industries"

ONE of the early applications of infra-red lamps for drying foods in a continuous operation has been put into successful service at the Gorton plant of Gorton-Pew Fisheries Co., Gloucester, Mass.

The new dryer built by the fish company to dry shredded salted cod was designed by Richard F. Fialho, plant electrician, and John M. Kohr, assistant food technologist, now production manager of the company.

Wartime necessity has forced the adoption of more rapid production methods so as to keep up a large volume on a reduced supply of available workers.

Shredded salt cod fish has been dried to about 60 to 65 percent moisture by so-called natural drying in the flake yards, but this moisture content is too high for ultimate safety against spoilage in tight packages in warm climate. Experience has shown that a moderate amount of artificial drying to further reduce the moisture content from 60 or more percent to 43 percent is necessary for freedom from possible deterioration under all conditions. Prior to 1943, the Gorton-Pew Fisheries Co. had used a cabinet dryer to achieve this margin of safety. This was a slow batch operation.



THE LAMPS HEAT the product as it passes under them on a wire cloth belt, and unheated air is blown through the product from underneath to cool the fish and carry off the moisture. Not shown are three electric fans which supply additional cooling and drying effect as the conveyor travels beyond the last lamps.

When Richard F. Fialho returned from a lighting conference he had the germ of the idea that was to speed up the drying operation and produce a better product. Drying is now continuous at the rate of 4,000 to 4,300 lb. per 7½ hours of actual operating time. Infra-red lamps in two banks of 112, each lamp drawing 250 watts, consume about 56,000 watts of power for the operation.

As worked out in this plant, the infra-red rays heat the product from the top while fresh cold air is blown through it from the bottom as it travels in a fluffy layer about ½-inch thick at six feet per minute.

The conveyor belt is stainless steel wire cloth made by Cambridge Wire Cloth Co. Lamps are both General Electric and Westinghouse, of 250 watts, installed in seven lamps per circuit and 76 lamps per panel. Three 100-ampere panels are required to handle the power load. The life of the infra-red lamps is about two years under this daily service.

Although the dryer works satisfactorily now, the company plans to install additional temperature control equipment to make it foolproof. In addition, an interlocking control system using equipment available at the plant is now being designed.

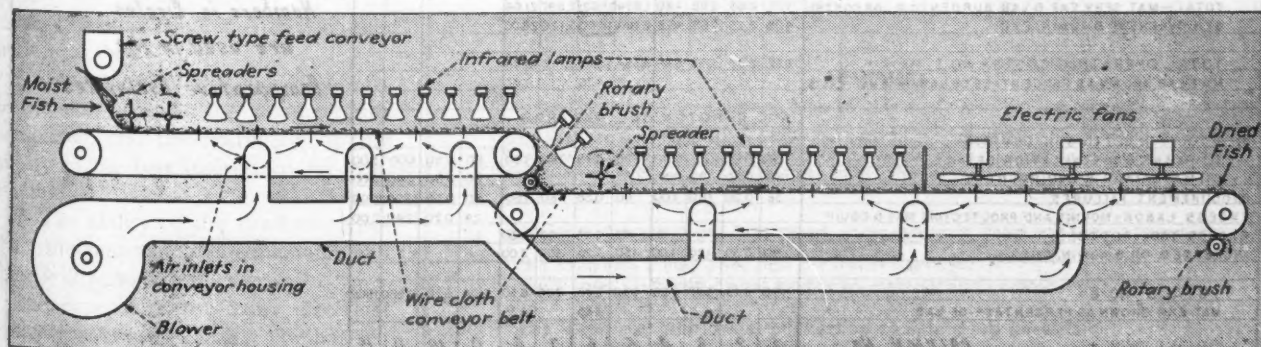


DIAGRAM OF THE INFRA-RED DRYER (elevation). The feed is at the left, then come two spreaders and a group of infra-red lamps. In the second stage, the product is spread

out by revolving paddles, passes under the second group of lamps and then under three fans. Air is blown through the product from underneath the conveyor in both stages.

Installation-Only

THE electrical contractor contemplating an agreement to install material and equipment, purchased and supplied by others, is confronted with two difficult problems:

1. Establishing a reasonable cost for the labor and service.
2. Establishing an equitable allowance for the gamble involved.

Although such agreements are commonly referred to as "labor only" contracts, there is much more than labor involved. In fact, there is no such a thing as a "labor only" job in the electrical contracting business. Electrical contracting is a service trade and along with the supply of labor must go the services and management. What the contractor really supplies is a complete installation service. The expression "labor only" minimizes the value of these services.

A buyer says he wants "labor only",

What are your operating costs on so-called "labor-only" jobs? The accompanying discussion and chart, compiled from contractor experiences and reliable surveys by the Research Department of the Electrical Contractors Association of City of Chicago, gives the answer. Study it carefully. It will help you establish your "service charges" on a sound basis.

but the following represents what he really expects to get:

1. Service of mechanics.
2. Tools furnished by the contractor. (Consumed and depreciated.)
3. Tools furnished by the mechanics.
4. Cartage for tools and construction equipment.
5. Field supervision.
6. Construction engineering services.
7. Construction and shop drawings.
8. Storage facilities for material and equipment.

9. Insurance.
10. Inspection.
11. Guarantee on work performed.
12. Testing.
13. Financing of the labor.
14. Services of the contractor's general office force and equipment, for accounting, time keeping, billing, etc.
15. Administrative management for coordinating all of the various functions.

If apprehensive about the adverse conditions which will be encountered,

INSTALLATION ONLY PROJECTS ... CHART 1												
APPROX. OPERATING COSTS SHOWN FOR A \$30,000. (COST-MAT. & LAB.) PROJ.												
ITEMS OF EXPENSE	MATERIAL EXP. MAT. BY OWNER \$10,000.				LABOR EXP. LAB. BY CONTR. \$10,000.				LABOR LOSSES DELAYS & DISRUPTIONS			
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
I-PRODUCTIVE ITEMS												
PREP FOR JOB												
STUDYING & CHECK'G PLANS-LISTING APPROX. MAT. & EST. LAB.	36	0.20	72	0.40	38	0.32	53	0.44				
CHECKING WITH ASSISTING OWNER'S PUR. AGT.	54	0.30	108	0.60								
EXPEDITING WORK												
FOLLOW UP & COORD. DELIVERY-MAT.	27	0.15	54	0.30								
STORAGE FACILITIES-FIELD			54	0.30								
SUPERVISION-FIELD					336	2.80	456	3.80				
JOB TOOLS-CONSUMED & DEPR.					420	3.50	684	5.70				
FIELD SHOP TOOLS							240	2.00				
CARTAGE-TOOLS & CONSTR. EQUIP.					12	0.10	60	0.50				
FIELD OFFICE & SHOP BLDG.							120	1.00				
ENGINEERING, CONSTR. DRAWINGS & STUDY TIME					240	2.00	480	4.00				
FIELD ENG. & TESTING					276	2.30	336	2.80				
FIELD TEL.							48	0.40				
BLUE PRINTING & JOB OFFICE SUPPLIES					36	0.30	60	0.50				
TRAVEL EXPENSE-OFFICE TO JOB					36	0.30	60	0.50				
TOTAL-MAT. SERV. EXP. & LAB. BURDEN (DIR. JOB COSTS)	117	0.65	288	1.60	1,394	11.62	2,597	21.64				
GEN. OVERHEAD & ADMIN. EXP.	405	2.25	765	4.25	2,160	18.00	3,120	26.00				
TOTAL OPERATING COSTS-NO. I	522	2.90	1,053	5.85	3,554	29.62	5,717	47.64				
MAT. EXP. SHOWN AS PERCENTAGE OF LAB. (THAN MAT. PERCENTS)							4.35	8.77				
II-POTENTIAL HAZARDS												
DIFFICULTY IN GETTING INFORMATION												
(1) PLANS & INSTALLATION DETAILS	36	0.20	72	0.40	90	0.75	180	1.50	60	0.50	600	5.00
(2) MATERIALS & EQUIPMENT	36	0.20	90	0.50					60	0.50	240	2.00
PROCUREMENT FAILURES	36	0.20	180	1.00	60	0.50	180	1.50	60	0.50	1,200	10.00
EXCESS LABOR-MOVING AND PROTECTING MAT. & EQUIP.									24	0.20	240	2.00
EXCESS TOOL COSTS					30	0.25	60	0.50				
INCREASED OH & ADMIN. COST	90	0.50	180	1.00	150	1.25	360	3.00				
TOTALS-NO. II	198	1.10	522	2.90	330	2.75	780	6.50	204	1.70	2,280	19.00
MAT. EXP. SHOWN AS PERCENTAGE OF LAB.							1.65	4.35				
COLUMN NO.	1	2	3	4	5	6	7	8	9	10	11	12
-THERE IS NO SUCH A THING AS A "LABOR ONLY JOB" IN THE ELECTRICAL CONTRACTING BUSINESS.-												
ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO												

SUMMARY SHOWN IN PERCENTAGE OF LABOR		
DIVISION OF EXPENSE	MIN.	MAX.
I-PRODUCTIVE		
LABOR BURDEN & OH	29.62	47.64
MATERIAL SERVICE	4.35	8.77
TOTALS NO. I	33.97	56.41
II-POTENTIAL COSTS-HAZARDS		
LABOR BURDEN & OH	2.75	6.50
MATERIAL SERVICE	1.65	4.35
EXCESSIVE LABOR	1.70	19.00
TOTALS NO. II	6.10	29.85
TOTALS NO. I & NO. II	40.07	86.26
SEE NOTE		

NOTE:-
INSURANCES, TAXES, AND INSPECTION COSTS
NOT INCLUDED.

Numbers in Circles
are used in the
Comparative Estimates

Projects

By **J. Walter Collins**
and
Ray W. Ashley
*Electrical Contractors Association
of City of Chicago*

an estimate will best serve the contractor's purpose if allowances for costs incurred by such adversities are shown as a separate figure. The main estimate should be set up, based on favorable working conditions, to establish a reasonable cost for the job. This is not easy, for an installation-only project. The time and care required to estimate such costs is greater than it would be if the contractor could select standard equipment, buy the requisite materials and place orders with firms that could be relied on to deliver materials when and as wanted. The difficulty involved, depends on the nature of the project and the completeness of the plans and specifications. Most contractors have experienced requests for a price on installations, where the information available and the job conditions were such that an intelligent estimate could not be prepared. If it is within the realm of possibility to make an estimate, the costs can be established in a manner outlined by the accompanying Chart 1.

Equitable Allowance For Gambles

In addition to the usual variables involved with the general run of work (complete installations, including material), on installation-only work the contractor must contend with two other major gambles:

1. The ability of the owner's organization to procure the material and equipment, and the exercising of that ability in the best interest of the contractor.

2. The ability of the vendors to deliver the material and equipment and their willingness to cooperate.

The experiences of many electrical contractors have greatly emphasized the hazards in connection with installation-only contracts. Some sidestep

[Continued on page 170]

CHART 2 COMPARATIVE ESTIMATES

1. CONTRACT FOR INSTALLATION ONLY (Material by Owner)

	LABOR
Base Labor Cost.....	\$12,000.00
Allowance for Delays and Disruptions.....10% ¹	1,200.00
Total Labor Cost.....	\$13,200.00
Insurance and Association Dues.....13%	1,716.00
Labor Burden.....12% ²	1,584.00
Gen'l Overhead and Admin. Expense.....18% ³	\$16,500.00
Material Service Expense 4.35% of 12,000.00 (2.90 x 1.5)	2,970.00
	522.00
	\$19,992.00
Return.....10%	1,999.00
Selling Price.....	\$21,991.00

Notes:

- ¹ Avg. for Excessive Labor, see Chart 1, summary II (circled)
² See Total Mat. Service Exp. and Labor Burden, column 6, Chart 1. (circled)
³ See Gen'l Overhead and Admin. Expense, Col. 6, Chart 1. (circled)

2. COSTS TO OWNER — COMPLETE JOB (Owner's Material and Contractor's Labor)

Base Material Cost (at contractor's price, though doubtful)	\$18,000.00
Cost of Material not adapted to job 3% (generally higher)	540.00
Total Material.....	\$18,540.00
Sales Tax.....2%	370.00
Cost of Purchasing and Handling.....5%	927.00
Total Cost of Material (Owner).....	\$19,837.00
Total Cost of Labor (Contract — Estimate 1.).....	21,991.00
(A) Total Cost of Job.....	\$41,828.00

3. CONVENTIONAL CONTRACT (Material and Labor by Contractor)

	MATERIAL	LABOR
Material Costs.....	\$18,000.00	
Sales Tax.....2%	360.00	
Material Service Expense.....1.54% ¹	277.00	
Gen'l Overhead and Admin. Exp....5.65% ²	\$18,637.00	1,053.00
Return on Material.....5%	\$19,690.00	984.00
Total Material (Costs and Return)...	\$20,674.00	
Labor Costs.....		\$12,000.00
Insurance and Association Dues.....13%		1,560.00
Labor Burden.....10% ³		1,200.00
Gen'l Overhead and Admin. Expense..15% ⁴		\$14,760.00
Return on Labor.....10%		\$16,974.00
Total Labor (Costs and Return).....		\$18,671.00
Material and Return (above).....	\$20,674.00	
Labor and Return.....	\$18,671.00	
(B) Selling Price.....	\$39,345.00	

Notes:

- ¹ From previous surveys, see Column 1, Table of Division of Operating Costs, page 25, *Electrical Contracting*, January, 1942.
² Same reference as for Note 1. (Overhead line under Material Handling)
³ When contractor has control of materials, his labor burden is less. In Estimate 1 it was 12%.
⁴ Same reference as Note 1. (Overhead line under Labor Supply)

4. OWNER SAVES BY LETTING COMPLETE JOB ON CONTRACT

From Estimates 2 and 3 we find the following costs:

(A) Total Cost with owner supplying material and contracting the labor.....	\$41,828.00
(B) Total cost with owner contracting complete job (material and labor).....	\$39,345.00
Estimated Loss to owner.....	\$2,483.00

HI-CYCLE SERVICE

Groups of motor-generator sets provide the hi-cycle current to operate high-speed hand tools at the North American Aviation, Inc., Dallas, Texas, plant.

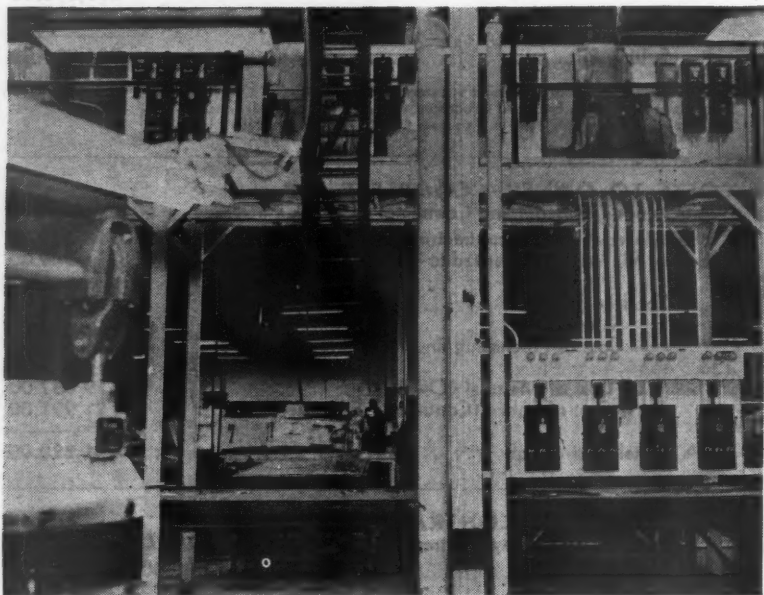


FIG. 1—HI-CYCLE GENERATORS are grouped on this balcony above a routing department at North American Aviation's Texas plant. The 250-cycle distribution board is on the balcony adjacent to the m-g sets. Generator board is at lower level for convenient paralleling of units if necessary.

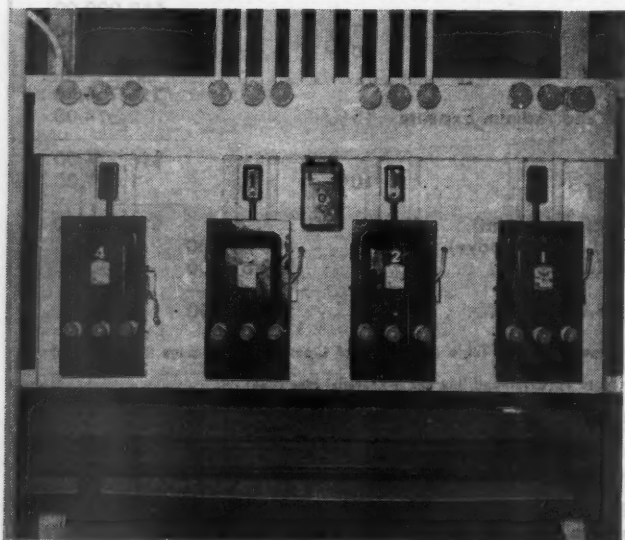


FIG. 2—PARALLELING GENERATOR BOARD for the four m-g. sets on balcony above is equipped with lamp indicators for fuse trouble and a set of synchronizing lamps in each switch for paralleling the individual sets on the 250-cycle bus.

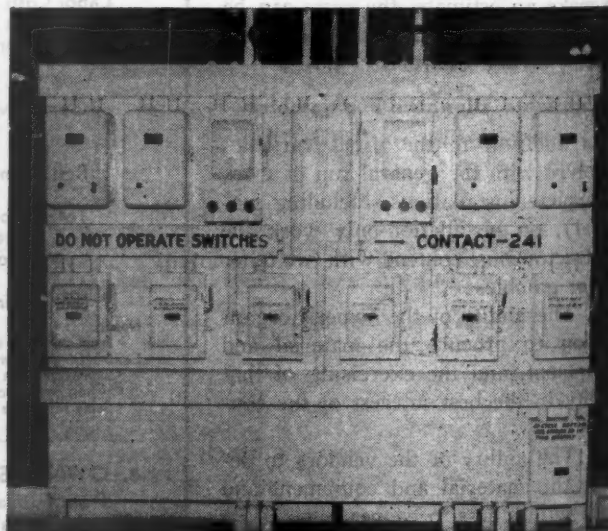


FIG. 3—COMBINATION CONTROL PANEL has motor-generator control and paralleling switches on upper half and hi-cycle distribution switches on lower half. Note bus trough arrangement for grouping of switches and space for additional units.

WITH the advent of the war, aircraft production was put on an assembly line, mass production basis. Aircraft manufacturers, in general, took a page from the experiences of the automotive industry. Hi-cycle electrical systems were installed to operate the high-speed hand tools required to maintain peak production schedules.

The power source for such a system at the Texas Division plant of North American Aviation, Inc., Dallas, is derived from a total of 16 vertical, belt-driven motor-generator sets (motor mounted on top of generator to conserve floor space) installed throughout the fabricating and assembly areas. Each of these 20 kva. units (output 40 amperes) converts the normal 440-volt, 3-phase, 60-cycle power to 350-volt, 3-phase, 250-cycle for distribution to the work stations.

High speed routers and drills developing 15,000 rpm.; hi-cycle portable tools including drills, nut runners,

AT NORTH AMERICAN

screwdrivers of variable speeds, and miscellaneous hand routing and special tool design equipment, are all operated by the high frequency current produced by these sets. Normally located in mezzanine areas to keep the assembly area free of obstructions, the sets are mounted in groups of two or more to assure power continuity should one unit fail and to insure ease of paralleling if necessary.

Circuit control is provided by numerous switchboards located adjacent to the sets on the balcony areas and in some cases on the assembly floor. Some of the boards include the generator paralleling equipment as well as the hi-cycle distribution switches; others contain only the paralleling switches. Fig. 2 is a close-up view of such a generator paralleling board controlling four, balcony-mounted, motor-generator sets for high speed routers and drills as shown in Fig. 1. The three, 150-watt, incandescent lamps mounted in the wiring trough over each generator switch flash an indication should a 30-ampere fuse be blown when the generators are paralleled. The three, 7½ to 10-watt lamps mounted to each switch are synchronizing lamps for parallel operation of the generators—the switch being closed to throw the generator across the 250-cycle bus when the lamps are out. Toggle switches above each paralleling switch start the motors of the m-g. sets.

The sequence of operation for paralleling the generators is simple. All toggle switches are thrown on the "on" position. Switch No. 1 is then closed, throwing generator No. 1 on the 250-cycle bus. When the synchronizing lights of switch No. 2 are "out", this switch is closed, throwing this unit across the bus; the same applies for the other units. To stop all units the procedure is reversed.

A combination paralleling and distribution board is shown in Fig. 3. The upper half of the panel controls the two

motor-generator sets. The 100 ampere switch in the center is on the 440-volt, 60-cycle line and feeds two sets of magnetic starters on each side. Each set of starters have interlocked controls with a single "start-stop" push-button—one starter controlling the driving motor, the other being for the generator field. Between these starters and the main switch are the paralleling switches for the generators. The bottom half of the panel contains seven, hand-operated, disconnect switches for 250-cycle power distribution to specific

plugs, work stations and trolley duct in the general assembly area. The 250-cycle equipment could be made automatic by using coils built for operation at that frequency.

Maintenance of the hi-cycle power service is no problem. Since it is seldom necessary to operate more than three of the units at the same time, servicing is simplified. A normal monthly maintenance check-up of all machinery and equipment is all that is necessary to keep the high frequency installation in top-notch running condition.

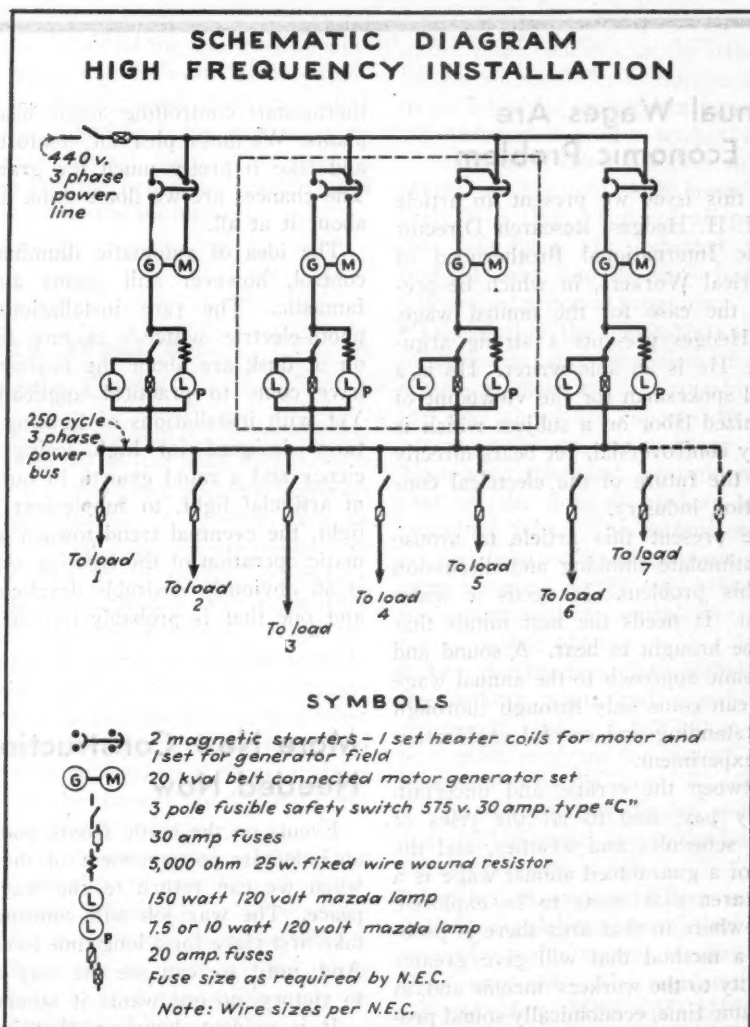


FIG. 4—SCHEMATIC DIAGRAM of typical combination control board for paralleling motor-generator sets and distribution of hi-cycle current to the various load centers in the plane fabrication and assembly areas.

EDITORIALS

W. T. Stuart, *Editor*

Annual Wages Are An Economic Problem

In this issue we present an article by M. H. Hedges, Research Director of the International Brotherhood of Electrical Workers, in which he presents the case for the annual wage. Mr. Hedges presents a strong argument. He is an able writer. He is a gifted spokesman for the viewpoint of organized labor on a subject which is highly controversial, yet bears directly upon the future of the electrical construction industry.

We present this article to arouse and stimulate thinking and discussion on this problem. It needs a wider forum. It needs the best minds that can be brought to bear. A sound and economic approach to the annual wage idea can come only through thorough understanding and careful exploration and experiment.

Between the erratic and uncertain hourly pay, tied to all the risks of work schedules and weather, and the idea of a guaranteed annual wage is a vast area that waits to be explored. Somewhere in that area there is probably a method that will give greater stability to the workers' income and, at the same time, economically sound productive payroll practice for the employer.

There is much of Mr. Hedges' argument with which we cannot go along. Nevertheless, we feel that it ought to be frankly and fully presented. We hope it will stimulate comment. Your thoughts and opinions will be welcomed.

Automatic Lighting Control

One of the most useful advances in comfortable living and working during the past 20 years has been the rapid growth of automatic heating controls. The heating problem, once a major winter chore, is almost forgotten in the efficient operation of automatic

thermostats controlling ample heating plants. We find it pleasant, comfortable and take it pretty much for granted. The chances are we don't think much about it at all.

The idea of automatic illumination control, however still seems almost fantastic. The rare installations of photo-electric switches to turn lights on at dusk are about the nearest we have come to practical applications. Yet with installations of lighting fixtures designed for high seeing efficiency and a rapid growth in our use of artificial light, to supplement daylight, the eventual trend toward automatic operation of the lighting system is an obviously desirable development and one that is probably not far off.

More New Construction Needed Now

Events on the battle fronts point to an indefinite postponement of the day when we can return to the ways of peace. The war job will continue to take first place for a long time to come. And, until we can see the way clear to victory, no one wants it otherwise.

It is evident, however, that in top planning we have merely halted the trends toward reconversion. Programs leading toward a resumption of civilian goods production and the relaxation of regulations have been stopped. Steps have been taken to prevent the flow of manpower to jobs outside of war production.

These moves are, for the most part, negative at a time when there is every indication that we need an increase in war production well beyond our previous programs. The reported critical shortages of war material may possibly be eased temporarily by stepping up worker productivity in existing plants. If victory were in sight, that would be the only sensible course.

But there is a long war ahead. The construction capacity of the country lies idle. It could produce vast new production facilities in a short time.

It could relocate industries crippled for want of manpower in areas where workers are available. It could produce the community facilities and housing which would immeasurably improve worker productivity and reduce turnover caused by bad living conditions.

A review of our war production plant and the supporting community facilities with a view toward increasing production on a broad scale and raising the productivity per worker to a high standard of efficiency is needed now.

Lighting Service A New Market

Planned lighting service is a new market available for development today. Most of the commercial and industrial fluorescent lighting installations of recent years are suffering from poor maintenance. The old practice of simply renewing lamps when they burn out is totally inadequate for modern fluorescent lighting systems. Cleaning and lamp replacement must be methodical if the light output is to be maintained within a reasonable range of the design values.

The electrical contractor who can set up a lighting maintenance service in his community is going to be well out in front when the way is cleared for new lighting sales.

The Need For Know-How

There is probably no field of electrical work where experience and know-how is as important as in industrial maintenance. The vagaries of electrical systems and apparatus are unpredictable. The text books can go only so far. From there on the maintenance man is a combination diagnostician, trouble-shooter, engineer, wire jerker and genius pitting his wits against gremlins whose ways are strange and devilishly ingenious.

Take the arc-to-ground troubles of WLC in Readers Quiz this month. Sturdy busbars, seemingly remote from the whirl of activity below, go berserk. Without apparent cause or reason, there is a heavy arc to ground. What happened? And out of the experience of others comes the answer—static with the power arc following the static spark. The cure is simple and inexpensive. Small resistors to ground prevent the building up of static charges.

Such troubles are by no means limited to busbars. Many of the unsolved breakdowns in wiring systems and in electrical apparatus, especially around terminal connections, can probably be credited to the same type of phenomenon. Wherever a static charge can accumulate and spark to ground followed by a destructive arc, the effect is similar to that of an insulation breakdown.

The maintenance know-how, the experienced understanding of what can happen to electrical systems and the appropriate measures to take for prevention or cure is an essential in meeting and solving problems like the static breakdown. That is why maintenance work requires so much of it. And that is why skilled maintenance work is one of our most exacting and difficult fields.

Joe Wants His Own Business

Will returning servicemen start contracting firms of their own with funds borrowed under the G. I. Bill of Rights? Some indications may be drawn from a survey made among the troops in this country and overseas by the Information and Education Division of the Army Service Forces.

They report that one enlisted man out of every eight plans to operate a farm or his own business. Seven percent have definite plans for operating a business, for the most part relatively small enterprises. And of those reporting definite plans, six percent named construction or contracting as their choice.

While the percentages are small, a rough calculation brings out a figure of approximately 40,000 men who have already decided to operate their own enterprises in construction or contracting. And of these, we can assume a considerable number will choose the electrical field.

The electrical contracting business

has never suffered notably from a lack of small firms. The "curbstoners" are legion. But he is characterized more by the way he conducts his business than by the size of his establishment. Small firms, modestly financed and intelligently managed, handle a very large portion of peace time electrical work. With growing electrical utilization demanding more wiring and more apparatus, there will be even wider opportunities for the small contractor after the war. And G. I. Joe, with his government backed loan for a starter, ought to bring new ideas, initiative and activity into the business.

They Want a Strong Code

We asked a group of our readers last month to tell us just what they thought were the important postwar problems of the industry. A number have already replied. And the preliminary returns show a considerable percentage calling for a stronger Code made more strict and better enforced. While the number of returns is still too small to provide the basis for statistical analysis, they do indicate that, if you select any group of electrical men concerned with construction, installation or maintenance, the chances are that most will want a strong Code.

This is not unexpected. The wartime Code amendments have been accepted, with some reluctance, as a necessary sacrifice to the requirements of war. A speedy return to more normal safety standards as soon as possible is an obvious course.

However, the comments with some returns indicate that electrical men are looking farther ahead. They see a growing industry with more wiring and more load. They foresee electrical systems becoming more complex and the need for safe standards becoming more acute.

The significance of such a reaction this year, while revisions to the Code are under consideration, is important. There is no tendency apparent to lower the bars even though war experience required many compromises with practices that were previously considered the minimum for reasonable safety. With all the signs indicating a rapid expansion of the electrical industry after the war, there is more reason than ever before to build sensible and practical safety rules backed by strong enforcement in every community.

Washington Notes

► Drastic curbs on current activities in the direction of reconversion, strengthening of "work or fight" manpower rules to hold older draft eligibles in war essential work, W. P. B. Chief Krug's warning that production programs must continue on the basis that the end of hostilities in Europe are off in the indefinite and distant future, are all evidence of a new temper in top Government circles. Recent military events, we are told, dash hopes of an early V-E Day. Tapered off production schedules are expected to be brought back and in many instances will exceed previous programs.

► Discounting the inevitable extremes of optimism and pessimism that are always at their worst in Washington, the days ahead are expected to bring severe curbs on reconversion plans. Manpower rules will be tightened to shut off the flow of workers toward peacetime jobs. The national service act may be brought out again and urged upon Congress as the only solution to the urgent need for controls over manpower in war plants.

► New construction plans include new tire making plants and expansion of existing facilities. A half billion dollar new plant program for mortar munitions is also on the way. Warehouses for surplus property display and storage until disposal are to be built by DPC at various points.

► Further changes have been made in O.P.A. regulations permitting those operating under several regulations to choose only one. The regulations are General Max. MPR 165, MPR 136, MPR 251 and others.

► A bill is expected to be introduced in Congress soon to authorize the Anti Trust Division to give advance opinions on whether proposed action of business men are in violation. Present informal opinion on proposed action provide no immunity from prosecution.

► U. S. war expenditures were running at the rate of \$273 millions a day, over \$7 billion a month during November. From July 1, 1940 through November 30, 1944, we spent \$236,700,000,000.

► Critical shortages still list manpower in first place, copper is again critical and castings still a bottleneck. Large stock piles of aluminum and magnesium are on hand.

► Maverick of SWPC wants \$500 million for small business reconversion loans. Eligible firms would be under \$250,000 annual sales.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

FLOATING POWER HOUSE

GENERATION

The recent completion of a power barge, the "Electra," for the U. S. Army Engineer Corps has caused electrical engineers to speculate on the potential postwar value of such mobile floating power plants for harbor and navigable river areas. Designed by the Army Engineers and built by General Engineering and Dry Dock Company, Alameda, California, this barge is capable of producing a power block of 6000 kva., and can be towed to any desired waterfront area to meet emergency or supplemental power requirements.

As a postwar unit, similar plants could be employed in cities providing harbor facilities as disaster or standby power stations. Depending upon the production demands in any harbor, this same unit could be used to supply additional power when a large block of electricity is needed for construction, ship loading or unloading. Although it has been said that it might not be practical to supply this power to shore transformers located more than a mile from the water's edge, engineers say such a barge could assist in equalizing the load demand on the utility company

supplying the area, when necessary or as desired.

The "Electra" has eight 750 kva., 2400 volt, 3 phase, 60 cycles, 720 rpm., Westinghouse generators driven by direct-connected Winton diesels of 1300 brake horsepower each. Power is fed through unit type switchgear, completely enclosed, to an outdoor-type substation mounted on the stern of the barge. This substation comprises three 2000 kva. oil-insulated self-cooled step-up transformers, from 2400 volts primary to 12000 volts secondary, through a switch house of 100,000 kva. interrupting capacity. The 12000 volt power is transmitted from the outdoor switch house through a cable to the dredge or substation being fed by the barge.

Auxiliary generators provide 240 volts alternating current for lighting and power requirements aboard ship. The auxiliary units are also diesel.

All generators, both main and auxiliary, are equipped with individual, direct-connected exciters.

The control room where the unit switchgear is installed is directly aft of the main generator room; the main power panel includes a separate control for each generator with metering and switching equipment. Adjacent to the main panel is the ship panel for the metering and distribution of auxiliary 240 volt power and lighting circuits.

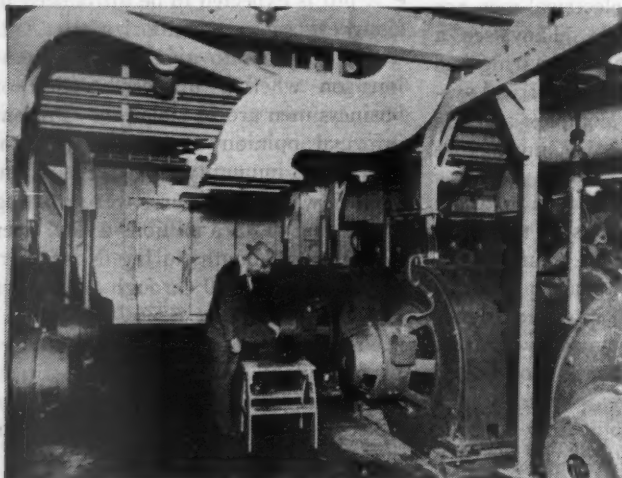
CABLE LUG DRILLING JIG

TOOLS

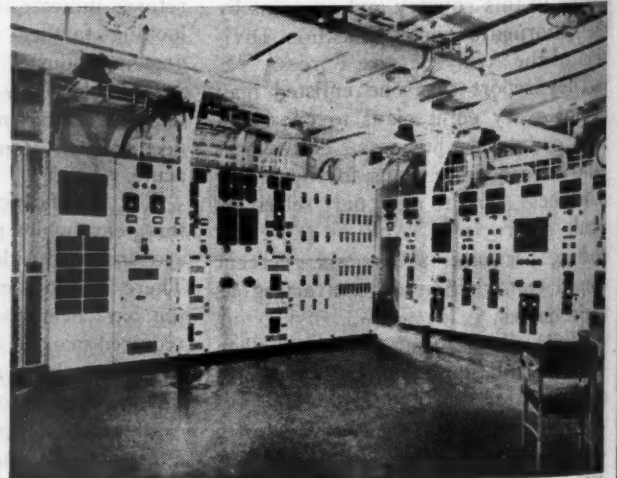
A turret-type drill jig has been designed by John Panella, of Marinship Corporation, Sausalito, California, for use primarily in drilling cable lugs, but useful in many other drill-press operations. With this new jig it is no longer necessary to endure the hazards of using an ordinary bench vise and hand drill. The flanged faces of the jaws safely and securely hold the lug on the press table during the drilling operation.

The jig is constructed on a channel-iron base and is shown in the accompanying diagram and picture. The clamping jaws are bolted to the ends of two pivoted arms. The opposite ends are equipped with rollers which ride on an eccentric spreading-cam. The spreading-cam has a handle and a locking bolt so that after placing the lug between the flanged jaws, the cam is rotated, spreading the rollers apart, tightly fastening the lug into place and is then locked in that position.

The moving jaws on the pivoted arms are turret type with each having four separate faces making the jig adaptable for numerous drilling operations. Thus, in one position, the oper-



BANK OF 750 KVA. GENERATING UNITS, which are diesel driven to provide block-power. Note each unit has an individual, direct-connected exciter, and note also thin rectangular duct for enclosing cables.



CONTROL ROOM directly aft of generating room. Main power panel on right is comprised of unit-type equipment, with each generator controlled from an individual panel complete with metering and switchgear. Auxiliary 240 volt panel is on center left.

SYLVANIA NEWS

CONTRACTOR EDITION

JANUARY

Published in the Interests of Better Sight and Sound

1945

Sylvania Launches Nationwide Poll On Postwar Lighting Preferences

*Interviews, Questionnaire Ads Will
Study Wants of Illumination Users*

Survey Advertising "Doubles in Brass" To Stimulate Sales

To learn what users want in lighting is the primary purpose of Sylvania's big 1945 advertising campaign in top consumer and business publications. But there's another vitally important aspect to this campaign. Every advertisement in the series will stimulate new interest, making users more conscious of the advantages of the lighting



Just look at that pile of magazines!
Every one of them will carry the new
Sylvania questionnaire campaign.

they will soon be able to get, compared
with what they have now.

Every ad, too, will build still broader
acceptance for Sylvania products—still
greater prestige and profit opportunities
for contractors who push the Sylvania
lighting line.

Taking a major step in its comprehensive program to make postwar Sylvania Lighting easier and more profitable to sell, Sylvania Electric Products Inc. has launched a nationwide survey to determine the lighting needs and preferences of industry, commerce, and the general public. Thousands of interviews will be conducted with the executives of manufacturing plants and com-

CONTRACTORS ACCLAIM MAINTENANCE PLAN

Electrical contractors are reacting enthusiastically to the new opportunities for profitable business offered by the Sylvania-sponsored plan for fluorescent maintenance service.

Under this plan, selected electrical contractors in every territory will furnish a complete maintenance service on a contract basis. Sylvania will provide technical assistance and business helps.

SYLVESTER SURVEY



"Pardon me, but do you plan to use
fluorescent lighting in your business
after the war?"



Here's Betty Light proudly displaying
the first consumer questionnaire ads.

mercial establishments, as well as with
domestic consumers, to form
one of the two main phases of
this intensive program.

The second phase of the
survey consists of a series of questionnaire
advertisements that will reach millions of
readers, among home-owners, and in
business and industry.

This survey will help guide Sylvania
in planning a postwar line with an assured
market—and big profit oppor-
tunities for contractors. Watch
for reports of the sur-
vey in future issues of
SYLVANIA NEWS.

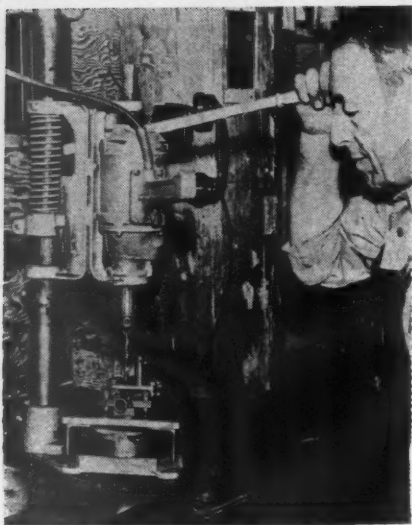


SYLVANIA ELECTRIC

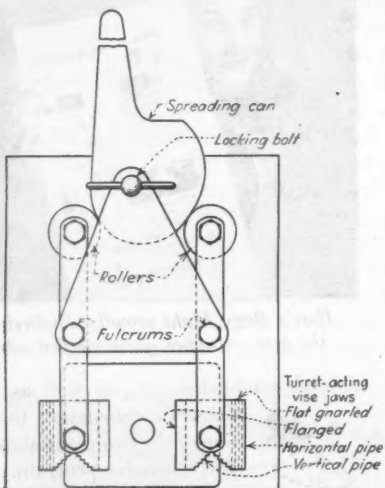
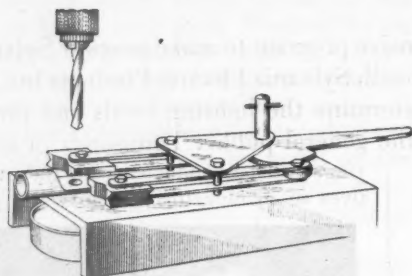
SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

Electrical Contracting, January 1945



CABLE LUG JIG rests on drill press table which is grooved to hold the jig from turning.



PLAN DIAGRAM and perspective of jig for use in drilling cable lugs and for general-purpose drilling. Note each jaw has four faces for holding different shape material.

ator has a set of horizontal pipe jaws, and in another he has a set of vertical pipe jaws. The third face makes a set of flat gnarled jaws while the fourth is flanged for drilling the lugs.

The materials are all standard metal shapes and wearing edges can be hardened after the required machining operations. The result will be a general-purpose jig that can be used on the drill press table for many other uses in addition to drilling cable lugs.

ELECTRONIC DEVICES SPEED PRODUCTION

INDUSTRIAL

In a southern textile plant, the solution to two vexing problems has been found in the application of electronic devices. The first was solved by photoelectric relays which, used to open doors automatically, saves time and, more important, helps maintain essential temperature and humidity conditions in the weave shed. The second was in the plant's opening room where an electronic time-delay relay is being used to shut down cotton feeding equipment for a selected period of time irrespective of the operation of other devices.

It is essential that the doors between the weave shed and the warp sizing room of this plant be closed as soon after opening as possible so as to maintain the much higher humidity and temperature conditions within the weave shed. In the mill's operations, trucks are constantly transporting reams of yarn between the two rooms. Also finished rolls of cloth must be brought back through and delivered to the cloth inspection room.

With ordinary doors opened manually, the humidity and temperature conditions were disturbed since the doors would remain open for a considerable length of time. In addition, manual operation meant that it was necessary for the truck operator or someone else to open the doors before the truck could pass through.

Photoelectric relays installed at the approaches to the doors now automatically open the doors as the truck approaches and close them as soon as the truck has passed through.

The electronic time-delay relay is applied in the opening room of the mill where cotton is removed from the original bale and then partially cleaned and fluffed up into a loose condition by special machinery. At times, the cotton being fed into this machinery accumulated to such an extent that it overflowed from the bin onto the floor, making it necessary for someone to replace it in the feeder hopper.

To shut down the feeding machinery automatically, a mercury switch was applied which trips when the cotton in the bin reaches a predetermined level. This wasn't the whole solution, however, since at this level the continuously rotating cotton in the bin was constantly tripping the switch. This meant repeated starting and stopping of the feeding machinery while the bin was full.

Supplementing the mercury switch with a G-E electronic time-delay relay solved the problem. Once the mercury

switch has initiated a shutdown period, the relay keeps the cotton feeding equipment inoperative for a preselected period of time, irrespective of the opening and closing of the mercury switch. After the time period has elapsed, the mercury switch again takes over to start the feeding equipment.

PLANE PLANT USES PORTABLE BATTERY LIGHTS

INDUSTRIAL

Industrial engineers of the Texas Division of North American Aviation, Inc., at Dallas, have taken a standard commercial battery-light unit and utilized it as the plant's second line of defense against power failure. These emergency portable battery units have been installed in all vital spots throughout both Texas plants as well as in all electrical, hydraulic control and air-conditioning rooms.

Each unit consists of a spotlight, a six-volt storage battery and a small copper sulphide rectifier built into the unit to charge the battery. The rectifier is fed by 110-volt current taken from special receptacles provided for this specific purpose. In addition to charging the batteries, this plant 110-volt supply also energizes a small holding coil which keeps the light off normally, but automatically turns it on when the power supply is interrupted. A toggle switch in the circuit permits opening the circuit in the event the emergency light is not needed during a power supply failure.

Three visible pilot balls, one to each cell of the six-volt battery, indicate the condition of the charge. If necessary, any overcharge can be easily dissipated



PORTABLE BATTERY LIGHT units take over upon failure of emergency lighting system of North American Aviation's Texas plants. Here, electrician A. J. Swirczynski illustrates the use of a twin battery unit in the plant's power house.

GREAT NEWS! SUPERIOR'S WELL KNOWN

Model 710

VOLT-OHM-MILLIAMMETER

is now available for shipment within 10 days after receipt of order on priority of AA3 or better.

Sensitivity—

1,000 OHMS PER VOLT
ON BOTH A.C. AND D.C.

Measures:—

A.C. AND D.C. VOLTAGES
UP TO—

1500 VOLTS

A.C. CURRENT UP TO—

3 AMPERES

D.C. CURRENT UP TO—

30 AMPERES

RESISTANCE UP TO—

10 MEGOHMS

Features:—

- ★ Uses New 4 1/2" Square Rugged 0-400 Microampere Meter.
- ★ Direct Reading—All Calibrations Printed Directly on Meter Scale in Large Easy-to-Read Type.
- ★ Housed in Rugged Heavy Duty Portable Oak Cabinet.
- ★ Completely Self-Contained—No External Source of Current Required.

Designed and perfected in wartime to meet the exacting requirements of America's War Producers for a dependable volt-ohm-milliammeter, the Model 710 is being used by war

plants engaged in the production of planes, ships, tanks, guns, etc.; also by various Army, Navy and other government agencies.

Specifications:—

6 D.C. VOLTAGE RANGES (1000 OHMS PER VOLT)

0 to 15/60/150/300/600/1500 Volts.

6 A.C. VOLTAGE RANGES (1000 OHMS PER VOLT)

0 to 15/60/150/300/600/1500 Volts.

7 D.C. CURRENT RANGES:

0 to 3/15/60/150 Milliampers

0 to 3/15/30 Amperes.

A.C. CURRENT RANGE:

0 to 3 Amperes.

5 RESISTANCE RANGES:

0 to 1,000/10,000/100,000 Ohms.

0 to 1 Megohm

0 to 10 Megohms.

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net weight 11 pounds. Price.....

\$ 34⁵⁰

SUPERIOR INSTRUMENTS CO., Dept. E. C.

227 FULTON STREET

NEW YORK 7, N. Y.

by merely burning the light from three to five minutes. When fully charged, the battery will furnish light for about 4½ hours. Although it is impossible to accurately estimate the life of a given battery, there are units two years old still in operation in both plants.

These portable lighting units are actually a secondary precautionary measure—the plant-wide emergency lighting system powered by a gasoline driven generator taking over during a power failure. If, however, this system also encounters trouble, the emergency battery lights are used.

PROTECTED OPEN WIRING SOLVES HEAT DISSIPATION PROBLEM

WIRING

When the electric heat treating furnaces were installed and connected at the Dodge-Chicago Plant, Division of Chrysler Corporation, where engines for the B-29 super bomber are made, heat dissipation from the conductors was carefully considered. Normally, the conductors to the control equipment would have been enclosed in a raceway of some type to enhance the appearance of the installation. However, both steel and copper were highly critical and the smallest consumption of these metals within the limits of good engineering practices was the goal.

Confining the conductors, from the 600 amp., 440-volt, 2-pole contactors on the electric furnace control, in an enclosed raceway would have required the

installation of larger copper than if open wiring were used. And the high ambient temperature of surroundings would also have added to the problem.

The logical answer to the heat dissipation was the use of protected open wiring with the natural air circulation lending a helping hand. Based on the temperature requirements and the availability of cable sizes at the time, 500 MCM Asbestos Type A insulated cables were used. The supporting angle iron rack for the contactors and control equipment was equipped with adjustable split porcelain insulators mounted to brackets on the vertical and horizontal members of the rack. These securely held the neatly formed cable runs.

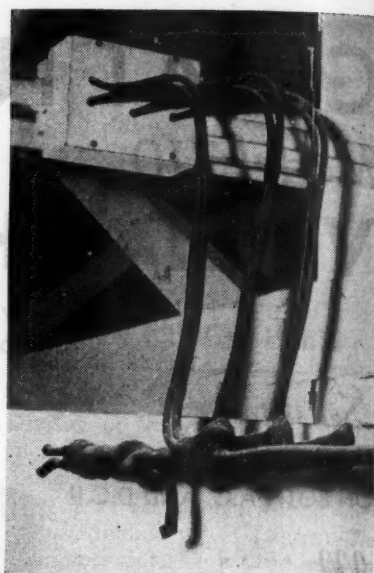
Careful workmanship on the part of the electrical contractors resulted in an installation that is neat in appearance, economical of material and satisfactory of operation.

LEAD SHEATH CUTTER

TOOLS

The removal of lead sheath from electrical cable is very often a tedious and dangerous task especially when done with knife or hacksaw. There is danger not only of injury to the worker doing the stripping, but also to the cable if the knife or saw should slip through to the conductor insulation.

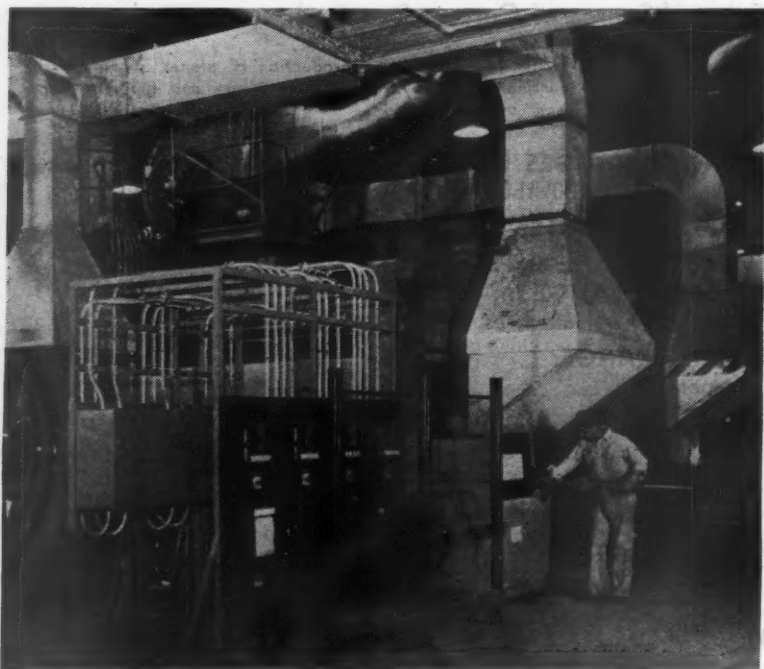
P. J. Ashcroft, a marine electrician at the Marinship Corporation, Sausalito, California, has devised a simple



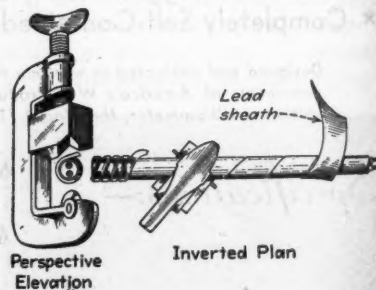
OPEN WIRING AND WOODEN construction were employed to by-pass the critical material situation and to get into production at Bethlehem-Hingham shipyard in Boston. Note the fabricated junction box with drilled asbestos cover. Use of conduit was restricted to circuit drops.

tool which quickly and safely removes the lead covering in much less time than by other methods, and at a cost of only about \$1.00 for materials for the cutter.

The device which is illustrated in the accompanying diagram consists of a C-clamp with a cutting roller in the stationary jaw and with a diagonally grooved block acting as the movable jaw. The result is that when the block



ELECTRIC FURNACE CONTROL at Dodge-Chicago plant employs asbestos insulated, protected open wiring to conserve critical materials and solve heat dissipation problem. Carefully installed, it presents a neat appearance.



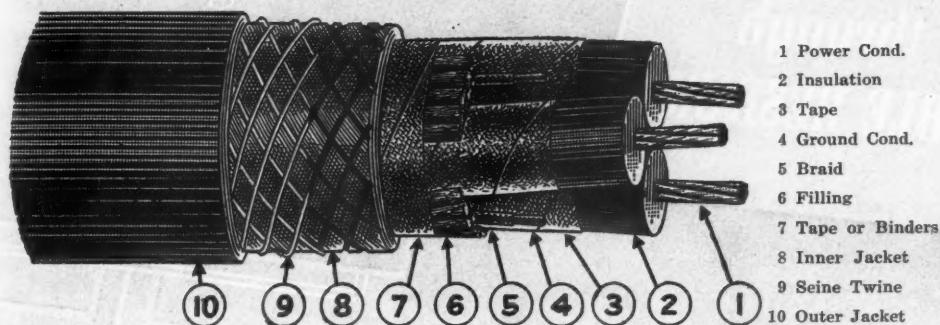
PERSPECTIVE drawing shows the C-clamp with the diagonally-grooved moving jaw and cutting wheel.

engages the lead-sheathed cable, the diagonal V-groove holds the cutting wheel at a skewed angle, so that as the clamp is rotated about the cable, the sheath is cut spirally. The lead can then be quickly unwound to the desired length.

The cutting wheel must be set into the stationary jaw to the correct depth so that the cutting edge protrudes only the thickness of the lead sheath to be cut. In this way, protection is afforded against cutting through into the insulation.

Performance Records

Prove Simplex-Tirex Quality



Simplex - Tirex Type G

If you could watch the manufacture of TIREX Cords and Cables, follow them step by step, process by process through our plant, you would clearly understand why they are so good. From the small copper wires that make up the flexible conductor right through to the smooth, tough, abrasion resistant rubber sheath, they are designed for hard service. Each is as good as we can make it and performance records furnish abundant evidence that there are none better.

Type W - without ground wires.
Type G - with ground wires.
Type SH-A - without ground wires, shielding over each conductor.
Type SH-B - without ground wires, shielding over cabled conductors.
Type SH-C - with ground wires, shielding over cabled conductors.
Type SH-D - with ground wires, shielding over each conductor.

trouble-free service.

If you need an electric cord or cable where flexibility, electrical stability and abrasion resistance are important you can trust TIREX. The satisfactory service that TIREX rubber sheathed cords and cables have rendered to mines, quarries, shipyards, railroads and industry of every sort during the past twenty-five years is ample evidence that they will not let you down now.

mammoth shovel or dredge. Careful selection of materials, skilled workmanship, frequent inspections and tests, these all lead up to a finished product from which it is reasonable to expect

A small TIREX cord for a portable tool is made with the same care and precision as a TIREX cable for a

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

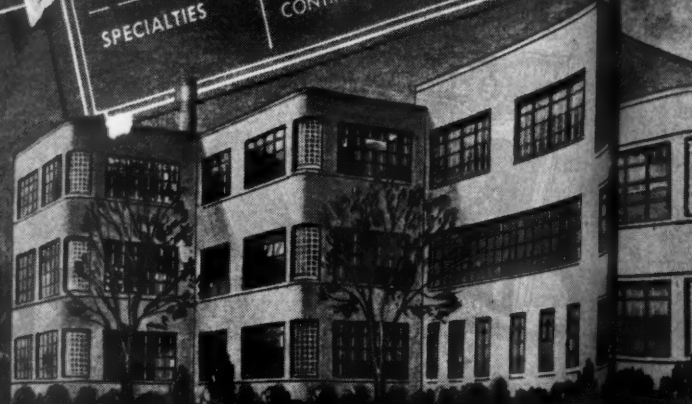
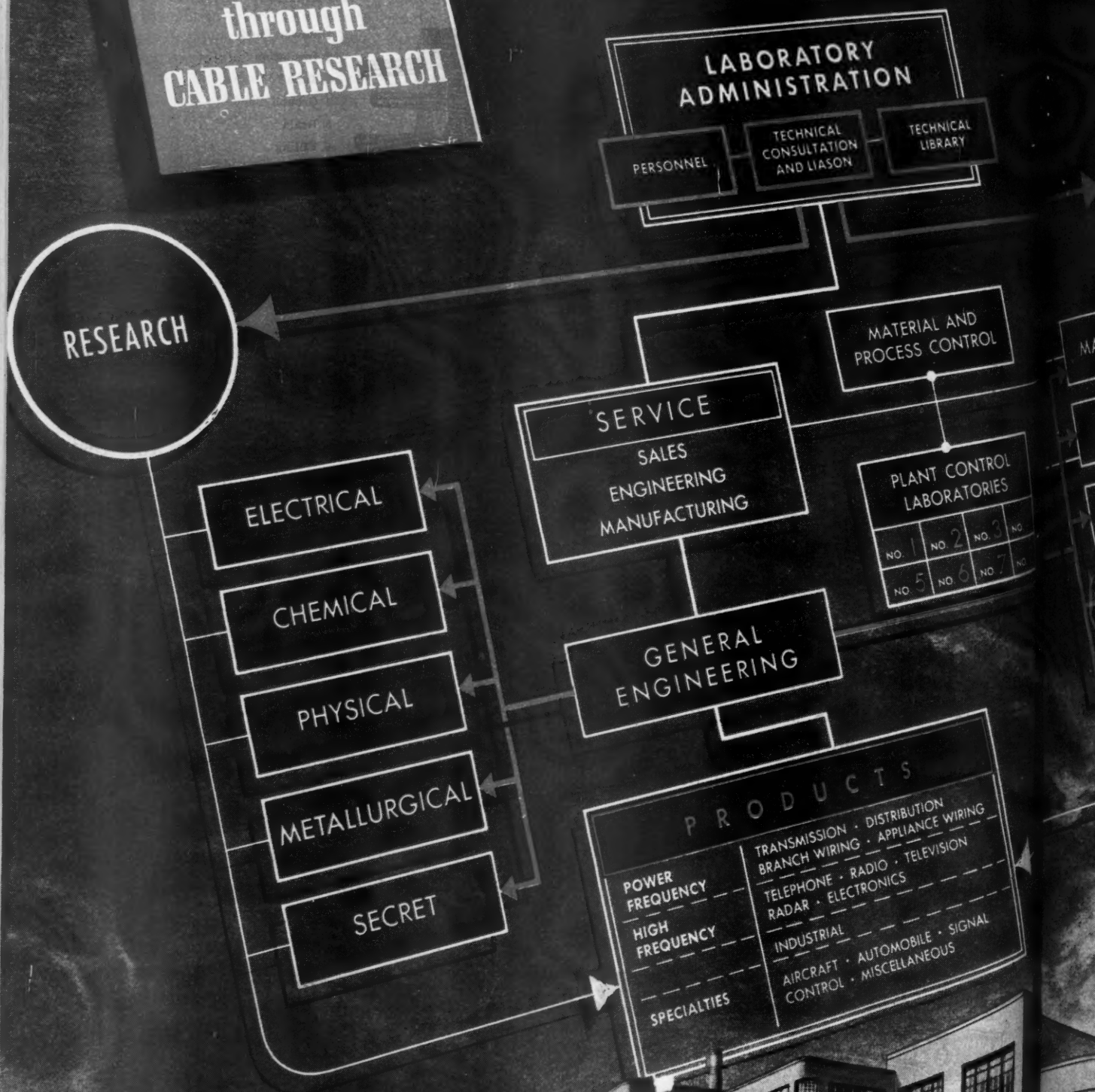


Simplex

WIRES and CABLES

Electricity...
MORE Useful to
MORE People
through
CABLE RESEARCH

SCIENCE



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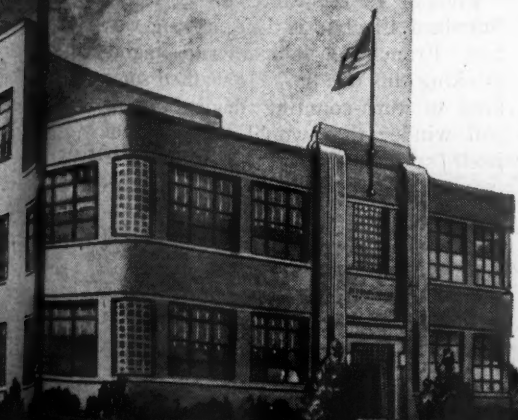
The General Cable Research Laboratory is by no means an end in itself. The great, new building, its facilities and scientific equipment are but an impressive and efficient tool in the hands of the men who are bringing into being this Company's far-visioned industrial program.

Here, pure and applied research go hand in hand with product development, to extend the use of electricity more usefully to more and more people. The achievements now in the making and the achievements of tomorrow will complement the substantial advances already "on the record", by virtue of which General Cable has won and maintained its position in the industry. Research is the spearhead of progress.

GENERAL CABLE CORPORATION



*Manufacturers of Bare and Insulated Wires and Cables
for Every Electrical Purpose*



MOTOR SHOPS

BAKING AND DRYING OVEN

To meet the dimensional requirements of large marine equipment, the Stark Electric Company of Baltimore, Maryland has provided larger facilities in their plant than is found in the usual motor repair shop. In addition to their immense bake-oven, the cleaning tank, stripping and burn-out furnace, and stock-room area are also of large proportion to adequately handle any job encountered.

The baking oven inside dimensions are eight feet by eight feet by eight feet high. In order to obtain efficient operation of such a large volume of oven space, it has been well insulated and sealed against heat-loss through careful initial design. The exterior shell consists of solid eight-inch brick walls, concrete floor and a five-inch reinforced concrete ceiling. Three-inch compressed black rock-wool monoblock lines the entire interior with the exception of the floor.

To facilitate loading and unloading, the whole front wall is used for door-opening. The sliding door is eight by eight feet and slightly over three inches thick. The three inch rock-wool monoblock is enclosed in sheet metal and suitably reinforced by strip-steel and angle iron for mechanical strength.



LARGE OVEN rated 30 kilowatts maintains operation at an efficient level thanks to eleven inches of insulation. Automatic temperature control provides good regulation over the baking and drying range.

The door, which slides upward on vertical rails is heavily counter-weighted for easy operation.

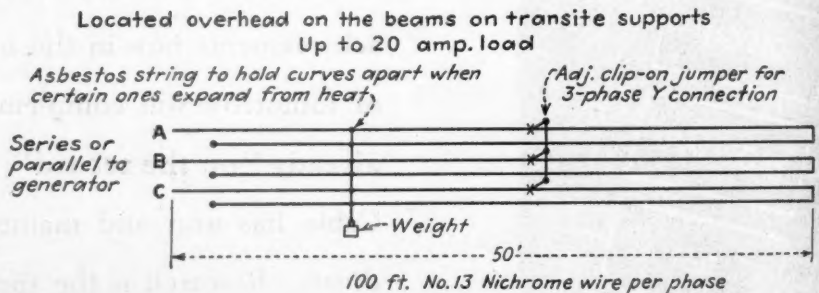
The 10 kw. resistance heating units are mounted about one and a half feet below the ceiling; one unit on each of the three inside walls. The three units are connected closed delta on the 220 volt three phase shop power feeder. The pipe-and-condulet wiring is run exposed as shown in the accompanying photograph.

Automatic thermal control is provided by the usual thermocouple-magnetic breaker arrangement switching the three delta connected units in one bank; that is, either full "on" or full "off". Extremely good temperature regulation is obtained to meet the various baking and drying requirements and conditions.

TEST LOAD WIRE MOUNTING

For testing three-phase generators up to 20 amperes, at 440 volts and also for d.c. generator tests, Kuchel & Sievers, San Francisco, use No. 13 Nichrome wire mounted overhead on the ceiling beams, using Transite supports. Connections are shown in the accompanying diagram, there being 100 feet of the Nichrome wire per phase and the circuits are so arranged that they can be operated in series or parallel to the generator. Three-phase Y connection is made as shown by using an adjustable clip-on jumper.

Certain wires under load when the others are not will heat and expand enough to sag and touch other wires in the system if not supported. This is



NICHROME WIRE suspended overhead on Transite supports is handy test load.

prevented by tying asbestos string to each wire and hanging a weight on the lower end. One or more of these separating devices may be used, depending upon the length of the circuits.

POSITIVE AUTOMATIC COUNTER FOR COIL TURNS

Pompey P. Scribante, owner of the Standard Electric & Engineering Co., San Francisco, laid awake nights thinking this one up. He wanted some kind of turn-counting device on his coil winder that would take care of itself, so to speak, so that if he were interrupted or called away from his work he could stop it and not have to remember anything but go right ahead and take up where he left off.

The schematic drawing pretty much tells the story. The whole thing is about 14 inches long. There is a

CROCKER-WHEELER MOTORS for ALL INDUSTRY

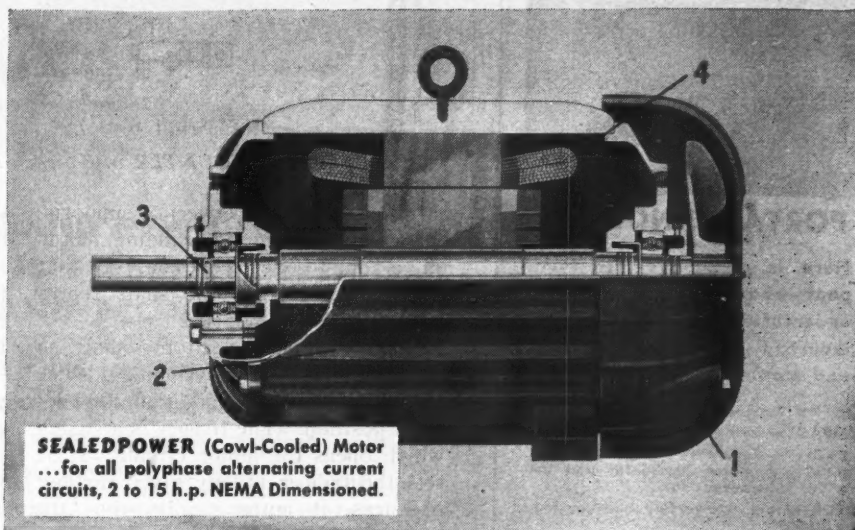
FEATURES

1. Totally Enclosed Cowl-Cooled type minimizes fire hazard, resists corrosion. Protects against acid or alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, lint, etc.

2. Fin Type single shell construction, with all surfaces exposed and a readily removable fan shroud, gives non-clog ventilation. Easy to clean...foreign matter passes over the surfaces of and not through the motor.

3. Patented GROOVSEAL anti-friction bearings — no greasing needed for at least a year — minimizes maintenance. Seal permits use of softer grease, for better lubrication and longer bearing life. Water-tight — Dust-tight — Air-tight.

4. Vacuum Impregnation with high grade insulating varnish seals out foreign matter and moisture from each individual coil...makes windings a homogeneous mass...reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires inside or outside of slot.



SEALEDPOWER...Industry's Most Trouble-Free Motor because...

YOU CAN DEPEND on a Crocker-Wheeler field engineer to recommend the power equipment *you* need. Behind him is 56 years of our company's experience...56 years of continuously developing facilities and skills *exclusively* in the power field.

Crocker-Wheeler, one of the

leading companies in the field, specializes **SOLELY** in the design manufacture and application of electric power equipment.

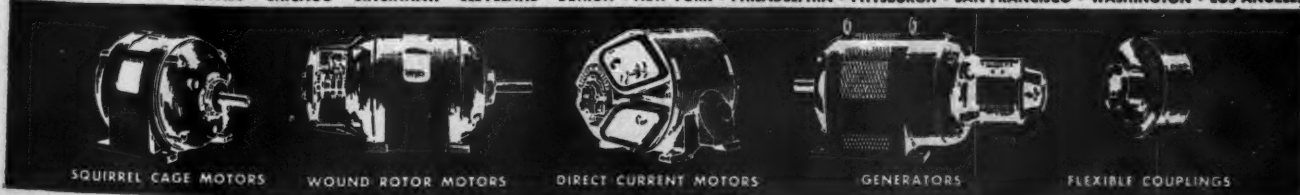
As power SPECIALISTS, Crocker-Wheeler field engineers know the power needs of your industry — of your particular production processes. Call in one of our experienced engineers for specific advice on motors, generators, control and couplings...no obligation.



JOSHUA HENDY IRON WORKS CROCKER-WHEELER DIVISION

ESTABLISHED 1856
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HULLHORST UNDERCUTTER



PORTABLE NO. 62

- Here is a lightweight—compact—handy—portable mica undercutter ideally suited for industrial maintenance men and motor repair shop crews.

LIGHTWEIGHT—Weighs only 4 lbs.

COMPACT—Gets into smaller spaces

CAPACITY—Undercuts commutators up to 30" diameter horizontal and up to 11" diameter flat.

MOTOR—Light, powerful, ball-bearing equipped

SMALL CUTTER—Allows smooth operation, gets closer to riser—lower cutting cost.

BLOWER—Ample for blowing mica dust away for best visibility

SIMPLICITY—Fewer parts than most undercutters—no flexible shafts to give trouble

The price of the No. 62 Undercutter with 110 Volt Universal motor includes carrying case, bar, screw driver and 20 Hullhorst High Speed Steel ($\frac{1}{4}$ " Cutters—4 each of .015", .020", .030", .035" thickness or assorted as you want them—\$37.50. Also furnished with 200 Volt Universal motor at slight increase in price.

HULLHORST

Mica Undercutter No. 10

A compact, high production, undercutting machine, handling armatures up to $6\frac{1}{2}$ " in dia. and shafts up to 17 $\frac{3}{4}$ " long. Built specifically for manufacturers and large electrical service shops.



V-Shape



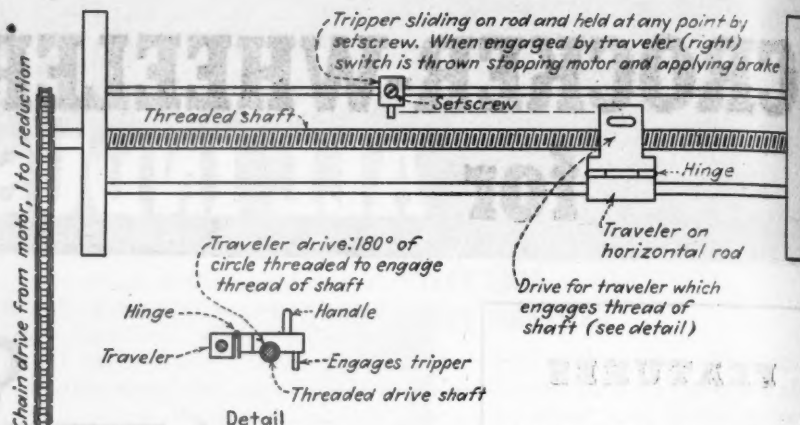
U-Shape

HULLHORST HIGH SPEED STEEL COMMUTATOR SAWS

An adequate supply of all important Standard sizes carried in stock. Specify Hullhorst for faster cutting—longer life—adaptability to all types of Mica Undercutters. In ordering give diameter, hole thickness and purpose for which intended.

HULLHORST MICRO TOOL CO.

Division of
TOLEDO STANDARD COMMUTATOR CO.
2242 SMEAD AVE.
TOLEDO 6, OHIO



AUTOMATIC COUNTER trips switch as preset number of turns is wound.

threaded shaft between supports, chain driven from the winding motor on a one-to-one reduction, so that every revolution of the shaft represents one turn on the coil.

On a rod parallel to the shaft he mounted a slideable tripping device with set screw to hold it at any desired position. The tripper is a switch which opens the motor circuit. If he sets the tripper at any given number of turns, it automatically stops the motor at that point.

On another parallel shaft runs a traveler, which is driven by a threaded member hinged to the main body of the traveler, so that it can be raised off from or dropped down on the drive

shaft at will. The under side of this threaded member is cut with threads similar to those on the shaft, the threads being on the interior of a half cylinder. When the traveler reaches the tripper it throws the switch.

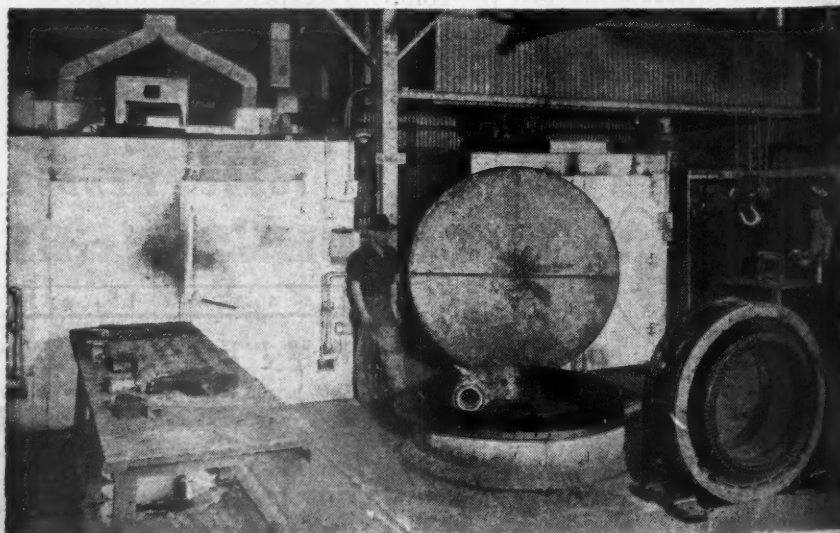
If the number of turns required are greater than represented by the number of threads on the shaft, the stopper can be set so that the total number of turns required will be a multiple of the number set off, the traveler being simply lifted up and taken back to zero and started over that number of times. Or, if he is interrupted he can stop the motor, leave the traveler where it is and resume later without hesitation.

"VARNISH-OPERATED" LIFT FOR DIPPING TANK

A varnish dipping tank of unusual design is operated by the R. A. Reed Electric Co. of Los Angeles. The tank is cylindrical and holds 600 gallons. It is installed with the top about six inches above floor level and adja-

cent to the oven, so that the equipment to be dipped can be lifted onto the oven car by crane, run into the oven and preheated, run out of the tank and immersed, and then raised and drained before running back into the oven for baking. Not a hand need to be laid to it in the process.

The diagram shows the location of the lift in relation to the tank. It is



TANK WITH TABLE in raised position and piece of work on top of it ready to be immersed upon lowering of the plunger.



OHIO



Burnishing Tools

for
COMMUTATORS

for
RINGS

A BRAND NEW DEVELOPMENT THAT IS EFFECTIVE, EFFICIENT AND ECONOMICAL

These Ohio tools are a recent development and are made of a material which when properly applied will give commutators or rings a clean, polished surface. During normal operation under certain conditions and often caused by improper brush application, a high resistance film forms on commutator and ring surfaces. This film is detrimental to the efficient operation of motors and generators. Previous methods of removing this film leave a fuzzy, shredded surface which gives way to a glass-smooth polished surface with the Ohio tool. Remember when the commutator or ring surface is clean and smooth, the brushes perform better with less noise, contact drop is more uniformly distributed and sparking is reduced. There is a style and size for every purpose and for machines from flea to heavy duty horse power. Sold under guarantee of absolute satisfaction.



CAN BE USED WHILE MACHINE IS IN OPERATION

Ohio Burnishing Tools can be used on a live machine because they are made of non-conductive materials. The illustration at the left shows how simply they can be applied. Periodic application gives motors and generators longer and uninterrupted mileage.



Our Bulletin No. 1019 gives complete information. Write for it!

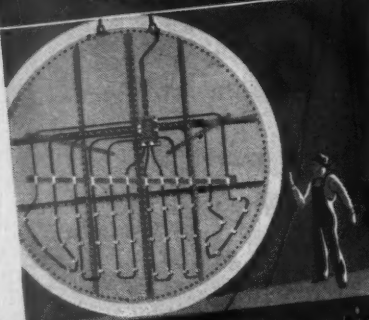
CARBON BRUSHES
designed to fit
YOUR
REQUIREMENTS

THE OHIO CARBON COMPANY

12508 BERA ROAD

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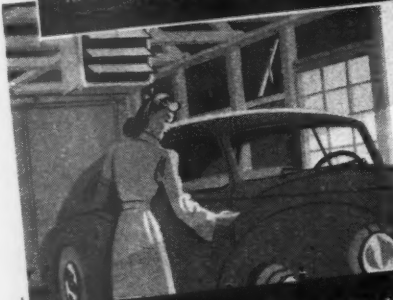
CUTLER-HAMMER ELECTRIC HEATERS
HAVE SOLVED THESE PROBLEMS—
AND HUNDREDS MORE



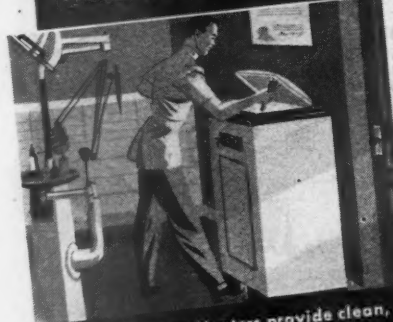
Cutler-Hammer Heaters keep dam roller gates free of ice.



Cutler-Hammer Heaters keep dies hot in embossing presses.



Cutler-Hammer Heater Units are used in many types of better heating devices.



Cutler-Hammer Heaters provide clean, automatically controlled heat for sterilizers.



Cutler-Hammer Heaters simplify thread waxing in shoe stitching machines.

Here's How

YOU CAN SOLVE THAT SPECIAL

HEATING PROBLEM

Do you want to heat the cab of a traveling crane ... or an isolated watchman's hut ... or a corner in some loft? Do you want "spot heat" a moving member in a special machine, or a plastic press, or a folding machine, a glue cooker or a shoe stitchee or a warming oven? Do you want heat that you can turn on and off at the touch of a button? Then you will be interested in Cutler-Hammer Electric Heat, tool of a thousand uses, capable of being shaped, applied and controlled in more ways than perhaps you ever thought possible. You may also be interested in the judgment of plant executives and machine designers who know the importance of the correct, efficient and economical solution of such heating problems. They have found that Cutler-Hammer's specialized knowledge in this field, dating from 1910, has been directly instrumental in securing to them the utmost advantages of the electric heating method. Why not write Cutler-Hammer today for details of Cutler-Hammer Electric Heat? CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ont.

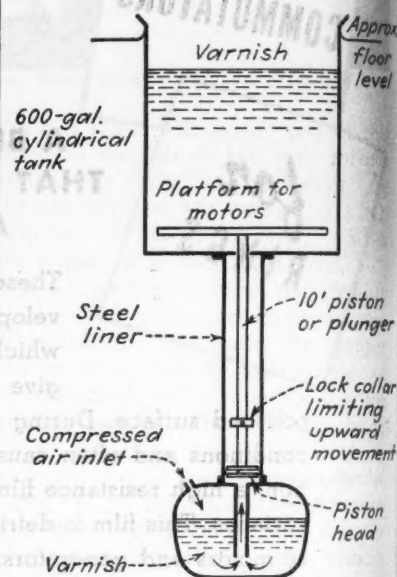


Engineering Excellence Finds its
Greatest Reward in the Respect
and Confidence of those it Serves



Cutler-Hammer Heaters keep incubators at a safe, even temperature.

a standard Globe hydraulic type lift ordinarily using compressed air and oil to raise the plunger. When negotiating with the manufacturer for purchase of the lift, the Reed company pointed out that the packing for the plunger at the entrance to the tank would need to be perfectly tight at the piston to prevent the entrance of any oil into the varnish, which would contaminate it. Since this could not be guaranteed, Reed's bought the lift anyway, and operated it with varnish.



SCHEMATIC DRAWING showing the arrangement whereby an automobile lift is used to raise and lower table in varnish tank.

Through a packed opening in the bottom of the tank passes the plunger of an automobile lift. A platform slightly smaller than the inner circumference of the tank is mounted on the upper end. This platform is raised to the surface and the object to be dipped placed upon it. The plunger is then lowered until the object is immersed.

INGENIOUS SHOP AIDS

R. E. Stormer of Stormer Electric Service in Muscatine, Iowa, has built some ingenious shop equipment from discarded machinery. A barber chair base with a circular platform bolted to the top provides a winding stand which may be rotated, raised and lowered to suit the convenience of the operator.

A winding machine was built from a separator base, geared with washing machine gears and a standard adjustable winding head. The spool rack is a piece of two inch pipe with three-eighths inch pipe cross arms set in a large truck brake drum for a base.



Symbol of Lighting Progress

12 NEW SPECIFICATIONS FOR INDUSTRIAL LIGHTING

- RLM Specification No. 1—**
Dome Reflector
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Deep Bowl Reflector
- RLM Specification No. 3—**
Symmetrical Angle Reflector
- RLM Specification No. 5—**
48" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Unit
- RLM Specification No. 6—**
48" Fluorescent Three-Lamp Closed-End
Porcelain Enamel Unit
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60" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Unit
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60" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Diffuser Unit
- RLM Specification No. 9—**
48" Fluorescent Two-Lamp Open-End
Porcelain Enamel Unit
- RLM Specification No. 10—**
48" Fluorescent Three-Lamp Open-End
Porcelain Enamel Unit
- RLM Specification No. 11—**
60" Fluorescent Two-Lamp Open-End
Porcelain Enamel Unit
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Porcelain Enamel Diffuser Unit
- *RLM Specification No. 13—**
Glassteel Diffuser
- *New RLM Approved Unit**

● For 25 years, manufacturers of RLM lighting units have worked together to give significance to their label. Much of this work was pioneering in fields of new design . . . its success is demonstrated by wide acceptance of lighting fixtures bearing the RLM label. The buyer now looks on this label as a symbol of lighting progress—one that symbolizes carefully engineered industrial fixtures.

The buyer of fixtures bearing the RLM label knows that he is getting:

- ★ Engineered Lighting
- ★ Economy through More Light at No Extra Cost
- ★ Low Maintenance Costs and Long Life

RLM progress in the past year is demonstrated by the table of new and revised specifications listed at the left. These specifications, representing months of careful engineering study, research and tests, establish new, higher standards for RLM industrial fixtures. Copies may be secured from RLM manufacturers, or direct from the RLM Standards Institute.

Write for Your Copies Today!

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers.

RLM STANDARDS INSTITUTE
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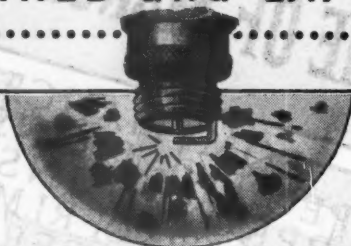
307 N. MICHIGAN AVE. SUITE 400 CHICAGO 1, ILL.

Severest Tests Show How Benjamin *Explosion-Proof* Fixtures *Insure against FIRES and EXPLOSIONS*

Shown here are some of the exacting laboratory tests which Benjamin Explosion-Proof Lighting Equipment must pass... and do pass with flying colors!

The dependability and safety of Benjamin Explosion-Proof equipment is to be found not only in the passing of these stringent laboratory tests but in the years of safe service it has rendered in thousands of installations throughout Industry.

In the solution of special lighting problems involving the use of this equipment, Benjamin's experience and engineering recommendations are available to you without cost or obligation. Write for Free Data Bulletins containing detailed information concerning all of Benjamin's hazardous location lighting units, all of which bear the label of the Underwriters' Laboratories and conform with all requirements of the National Electrical Code. Address Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Illinois.



Thirty Severe Spark Plug Tests Demonstrate How Benjamin Explosion-Proof Fixtures Confine Explosions to Interior of Fixtures!

In this test, a spark plug is used to create ignition of explosive mixtures within the fixture. THIRTY EXPLOSIONS are thus created at 380 lbs. per sq. in. pressure! Benjamin units withstand these explosions. The fixture is neither destroyed nor damaged! There is no escape of flames or dangerously hot gases to the surrounding atmosphere.



Flame Proof Joints

All threaded and flanged joints in the fixture are made to a specified depth that positively insures against passage of flame.

Approved by Underwriters' Laboratories for use in Class I, Group D hazardous locations. Under labeled re-examination service units are taken from the production line and periodically checked by the Underwriters' Laboratories to insure conformance to their rigid standards.

FOR LIGHTING SUCH LOCATIONS AS...

Oil Refineries, Lacquer Spray Painting, Natural Gas Plants, Dry Cleaning Plants, Artificial Leather Manufacturing, Paint and Varnish Works, Oil and Gas Wells, Pyroxylin Plastics, Moulding, Distilleries, Chemical Plants, Linoleum and Oilcloth Manufacturing. Pipe Line Pumping Stations, and other locations where highly flammable gases, mixtures or other highly flammable substances are used, handled, or stored in other than their original containers.



Temperature Controlled

Every Benjamin Explosion-Proof fixture operates at a carefully controlled temperature that precludes any possibility of the fixture heat causing an explosion in the explosive atmosphere in which it is installed.



BENJAMIN

TRADE MARK



Lighting Equipment

Distributed Exclusively through Electrical Wholesalers

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

Selection and Application of Synchronous Motors—II

General purpose and large high-speed synchronous motor characteristics can be used to advantage in many industrial applications where constant speed and better overall power-factor is desired.

An arbitrary division between high-speed and low-speed synchronous motors has been established by the electrical manufacturers at 500 rpm. That is, all motors whose synchronous speed is 500 rpm., or higher are in the high-speed group. This group is further divided into general purpose motors, which are those rated 200 hp. or less at unity power factor; or 150 hp. or less at .80 power factor. Higher ratings fall into the large high-speed group.

Certain standards have been established by the synchronous motor industry and are the basis for motor design by all reputable manufacturers. Standard torques, for examples, are shown in Table I. Values as listed are recognized standards. As synchronous motors are oft-times custom built for their specific application, torques either higher or lower than those listed can be obtained. As the starting current inrush is affected directly by the motor torques, special motor design pays good dividends in some instances.

Torque Versus Starting Current

High-speed synchronous motors frequently have more than sufficient normal starting and pull in torques for their specific application. It is sometimes desirable to reduce these values to reduce starting current. The use of single or double cage, special forms and slotting of the field poles, and the use of various alloy cage bars permit a wide variation in the resistance and reactance of the squirrel-cage starting winding. This, in combination with

By A. P. Burris,
New York District Manager
Electric Machinery Manufacturing Co.

variations in reactance of the stator winding is used to get the best starting performance for each application.

Where *high starting torque* and *lower pull in torque* is desired, a single cage high resistance winding would be used. Curves 1 of Fig. 1 illustrate the starting characteristics of a 600 hp., -900 rpm., .80 power factor synchronous motor driving a hammer-mill for crushing limestones.

Where starting torque requirements are *low*, and pull in torque *high*, as on a centrifugal pump drive, a high reactance, low resistance cage, together with a stator having a low reactance, are used. Curves 2 in Fig. 1 illustrate

this example for a 400 hp., 1200 rpm., .80 power factor motor.

On such drives as ball or tube mills, rubber mills, flour mill line shafts, or other high inertia loads, both high starting and high pull in torques are required. Here a double cage winding is generally used, of the type illustrated in Fig. 2. This results in a high sustained torque curve through the accelerating period with a high torque efficiency (high increment of torque per increment of kva.). In addition, it has the high thermal capacity necessary to withstand the heating during the relatively long acceleration period.

The General Purpose Group is, as a rule, designed and manufactured in accordance with the standard torques established for the line, as these torques are sufficient for most applications.

TABLE I

GENERAL PURPOSE GROUP

Rating	No. of Poles	% Starting Torque	% Pull-in Torque	% Pull-out Torque
Up to 200 HP. at 1.0 P.F.	4	110	110	150
	6-14	110	110	175
Up to 150 HP. at .80 P.F.	4	125	125	200
	6-14	125	125	250

LARGE HIGH SPEED GROUP

250-500 HP. at 1.0 P.F.	4-14	110	110	150
200-500 HP. at .80 P.F.	4-14	125	125	200
600 HP. and up, 1.0 P.F.	4-14	85	85	150
600 HP. and up, .80 P.F.	4-14	100	100	200

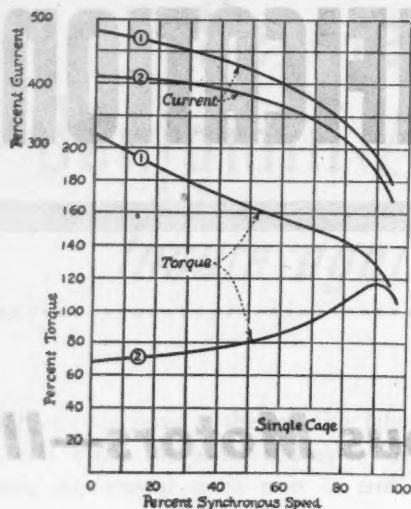


FIG. 1. Starting characteristics of a 600 hp., 900 rpm., 80 percent p.f. synchronous motor driving a hammermill are shown by curve 1. Curve 2 shows the starting characteristics for a 400 hp., 1200 rpm., 80 percent p. f. motor used for centrifugal pump drive.

Thus the tendency is away from the custom building of these ratings for the particular drive on which the specific motor will be used. The savings so made by the motor manufacturer are passed on to the purchaser in the form of lower prices. At the same time, the user receives the advantage of the synchronous motors better inherent operating characteristics on efficiency and power factor.

With the inherent higher manufacturing cost and selling price on the Large High Speed Group, each motor can carry an increased dollar cost for special engineering design. This permits detailed consideration to the users special problems on such points as torques, efficiencies, or starting current. Even though a motor price addition results in some instances from such special features, a net reduction in cost may result when both initial costs and operating costs are considered.

On a synchronous motor-generator set for example, the driven generator does not carry load until it is running at its operating speed, or the driving motors synchronous speed. Thus through the starting period, and while pulling into step, the driving synchronous motor need overcome only the inertia, windage, and friction of the moving parts in its acceleration. This means that an average starting and pull in torque of 40 to 50 percent will suffice. Such torques may generally be obtained with a current inrush of 375 to 400 percent whereas standard torques of 110 percent would result in starting currents of 500 percent or more.

With public utilities generally limiting permissible values of current inrush, the lower values might successfully be handled with full voltage starting. The higher standard torques however, with their inherent higher inrush would probably require a current reducing type of starter such as part winding or reduced voltage, thereby materially increasing the first cost of the installation.

The tabulation in Table II lists approximate full voltage starting kva. of unity power factor high-speed synchronous motors. For 80 percent power

TABLE II

Starting	Percent Torques			Percent Starting KVA.
	Pull-In	Pull-Out		
50	50	150-175		375-400
50	75	150-175		400
75	75	150-175		400
75	110	150-175		500
110	110	150-175		500
125	110	200-250		550-600
150	110	150-175		550
175	110	200-250		600-650

factor motors, the values will be 80-85 percent of those lists. The given values are not industry established standards but, instead, are merely approximated values to show about what may be anticipated.

Voltage and Frequency Variations

During the war period, with the scarcity that has existed in certain metals and alloys, design engineers have been handicapped in their selection of materials. As a result, it has not been possible to work out designs in some cases to give the low starting kva. per increment of torque that had been obtained previously.

Synchronous motors will operate under variations of voltage and fre-

quency, but not necessarily in accordance with the standard performance guaranteed or established for operation at normal rating. For example, successful operation can be obtained with a variation in voltage of 10 percent above or below normal; or a variation in frequency of 5 percent above or below normal; or a variation in both where the sum of the two does not exceed 10 percent (provided the variation in frequency does not exceed 5 percent) above or below normal rating as stamped on the nameplate. Selection of motor torques should take possible voltage variations into consideration to assure successful operation.

Frame Constructions

High-speed synchronous motors may be obtained in several different types of frame constructions. The bracket bearing type, as illustrated in Fig. 3, is probably the most commonplace. Here the two end-bells or brackets support the motor bearings. All of the general purpose group and many of

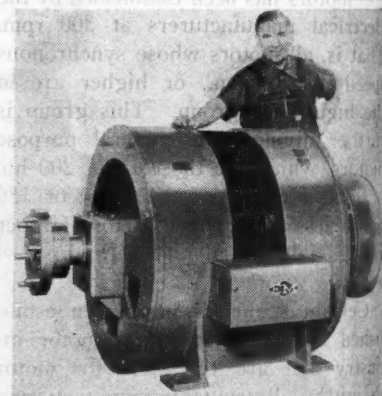


FIG. 3. Bracket-bearing type synchronous motor used for direct connection or belted service. Motor bearings are supported by the end-bells.

the smaller ratings in the large high-speed group are generally built on this type frame. It is offered for direct connection to its load, or can include a sliding base for belted service.

The packaged synchronous motor, in the bracket bearing type, has found wide acceptance since it was first offered several years ago. Fundamentally, the full voltage control for the synchronous motor consists of an equivalent line starter to be used for a squirrel cage motor, plus the addition of field application equipment. The latter consists of a field contactor to apply direct current excitation to the motor field, plus an actuating relay to make it automatic.

This field application equipment can conveniently be mounted on the motor

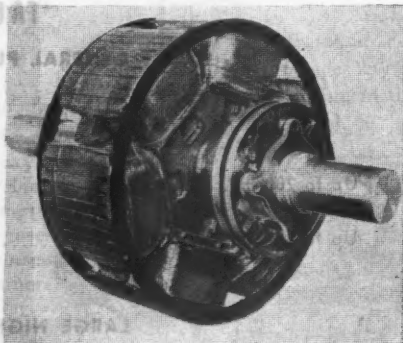


FIG. 2. Double-cage winding is shown on a 300 hp., 1200 rpm., synchronous rotor. The motor is used to start and drive a high inertia load such as a line shaft, rubber mill or ball and tube mill drive.

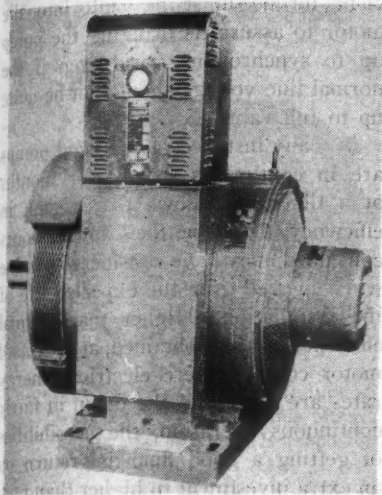


FIG. 4. Packaged synchronous motor is complete unit in itself. Only external connections are the three a.c. leads from the linestarter. This motor is rated 75 hp., 1200 rpm.

frame and all electrical connections between the exciter and field control apparatus made at the motor manufacturer's plant. Such a complete unit arrangement is referred to as a packaged synchronous motor, is included in the general purpose group, and is shown in Fig. 4. The cost of installation is appreciably reduced as only the three leads from the linestarter to the terminals of the synchronous machine must be connected.

Large High-speed Motors

In the larger horsepower ratings of the high-speed group, the pedestal-bearing type of construction, as illustrated in Fig. 5, is used. Generally of two bearing construction, its rugged pedestals and bearings are designed for the heavier loads imposed upon them because of the larger horsepower.

However both general types of construction can be altered to fit existing conditions and requirements. Single bearing motor construction, where half of the rotor weight is carried by the near bearing of the driven machine, may prove to be a factor in saving valuable installation space. Or on a centrifugal pump installation for example, the pump manufacturer often furnishes a common base under both the pump and motor. In such a case the pedestal-bearing type of motor would be furnished without base, and the motor bearing pedestals mounted directly on the pump base extension. These, and other modifications, can be incorporated into the design to make the resultant installation the one best adapted for the users requirements.

Deep well pumps, requiring driving motors of 100 hp. up to approximately

500 hp. make a good synchronous motor application. This of course uses a vertical type motor. The weight and thrust load of the pump shaft and impellers is handled by a thrust bearing, usually incorporated in the pump. In such cases the motor-bearing supports only the thrust load imposed by the motor. Sometimes the total thrust load is carried by the motor bearing. With this arrangement the motor has a hollow shaft with the pump shaft inside. By having the pump and motor shafts separate, the necessary adjustment of the pump shaft can be made without affecting the motor.

Protective Enclosures

To assure the user of many years of trouble free synchronous motor performance, it is important that proper consideration be given to protective motor construction features that the installation may warrant. Open-type is used on a majority of applications of course, but the more expensive protective construction is often justified.

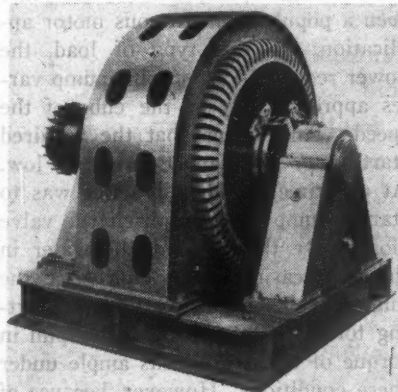


FIG. 5. Pedestal-bearing type of construction is used in synchronous motors of the large high-speed group to meet the requirements of more rugged service.

Some of the types of motor location, and a suggested type of motor protection are:

1. Motor subject to dripping, spilling, or splashing liquids. Use a drip-proof or a splash-proof motor.
2. Motor subject to rapid clogging from excessive amount of dust, lint, shavings or other material. Use an enclosed self-ventilated motor, or enclosed separately-ventilated motor.
3. Motor subject to deterioration from abrasive or conducting dust, or corrosive fumes or spray. Use an enclosed self-ventilated motor, or an enclosed separately-ventilated motor, or a totally enclosed fan-cooled motor.

4. Motor operates in atmosphere containing explosive gases.

Use enclosed collector rings, ventilated, or explosion-resisting, or an enclosed, separately-ventilated motor, or totally enclosed, fan-cooled, explosion-resisting motor.

A drip-proof synchronous motor is a motor so protected by covers or hoods, that any particles falling on it at an angle of not greater than fifteen degrees are prevented from entering.

The splash-proof synchronous motor (shown in Fig. 6) has enclosures, open at the bottom, and baffles within the enclosures so that particles coming at the motor at an angle of not more than 100 degrees from the vertical (ten degrees below the horizontal) are prevented from entering.

In an enclosed self-ventilated motor, the cooling air is circulated by fan blades which are part of the rotor, or by fans within the motor enclosure and keyed to the motor shaft. The cooling air may be taken from the motor room, through a filter which cleans it, or from an outside source of clean air. It may be exhausted from the motor into the motor room, or elsewhere through duct work.

A similar arrangement of self-ventilated motor uses an air cooler, generally located directly below the motor. The cooling air within the motor is then not changed but is continually recirculated within the closed circuit formed by the motor, the cooler and a short duct work system.

An enclosed separately-ventilated motor is similar to that described in the preceding paragraph except that the fan or blower is driven by a separate motor. This permits the use of longer duct work and also allows air circulation when the synchronous motor is at a standstill.

Where external conditions are too

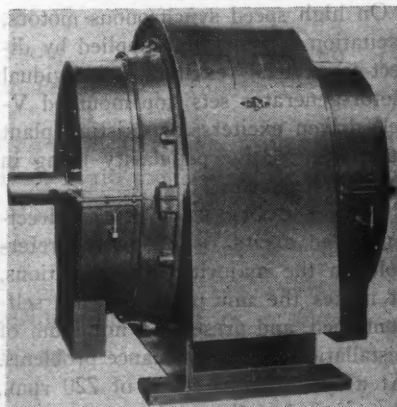


FIG. 6. Splash-proof enclosure on a 400 hp., 1200 rpm., synchronous motor to protect it against splashing liquid and particles.

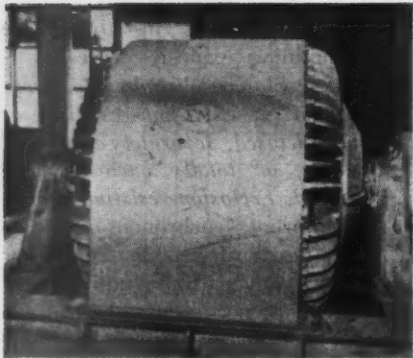


FIG. 7. Totally enclosed fan-cooled synchronous motor rated 300 hp., 900 rpm., driving a hammermill for crushing bauxite.

severe for an open type motor, and where it is not practical to pipe clean air to an enclosed, self- or separately-ventilated motor, then a totally enclosed fan-cooled synchronous motor should be considered. The electrical and magnetic structure of the motor is totally enclosed. The air within the enclosure is continually recirculated to carry the heat to the motor casing from which it is removed by external fans. Such a motor is shown in Fig. 7. Its use has eliminated very long duct work that would have been required to furnish clean cooling air, plus the cost and maintenance of a filter, had a separately-ventilated motor been used.

Totally enclosed, fan-cooled, explosion-resisting synchronous motors are often required to meet existing requirements. Their frames are not necessarily gas tight but they are designed to withstand an internal explosion and to not communicate an internal flame to the outside gases.

Serious consideration should be given to protective enclosures for synchronous machines when such a unit is to be installed. A higher first cost may add many years of trouble-free service.

On high speed synchronous motors, excitation is generally supplied by direct-connected exciters, individual motor-generator sets, top mounted V-belt driven exciters, or existing plant bus, with relative popularity being in the order named.

First cost not considered, the direct-connected exciter is definitely preferable on the majority of installations. It makes the unit complete and self-contained, and presents a minimum of installation and maintenance problems. At a synchronous speed of 720 rpm., the cost of a direct-connected exciter is approximately equal to that of a motor-generator set. Thus, at 900 rpm., or higher, direct connected ex-

citers are used in most cases. Below that speed, the m-g set is generally the cheaper form of excitation between the two.

At 514 and 600 rpm. synchronous speeds, the top mounted V-belt driven exciters have found favor. Such a type reduces the overall length of the motor slightly, and of course needs less floor space; but at the same time it introduces a maintenance item in the V-belt drive.

Typical Applications

In general, high speed synchronous motors can be designed and manufactured for most constant speed applications. Suitable torques can be obtained, and even when these values are high, resulting in high starting-current inrush, proper selection of control equipment will give increments of starting current within the limits of most power company requirements. The following typical examples illustrate the general factors affecting the desirability of certain synchronous motor characteristics.

Centrifugal pumps have for years been a popular synchronous motor application. In this type of load, the power required by a specific pump varies approximately as the cube of the speed. This means that the required starting or breakaway torque is low. At one time, common practice was to start a pump with the discharge valve closed. By this method, the water in the pump casing merely churned as the pump impeller began rotation. A starting torque of 30 percent and a pull in torque of 60 percent was ample under these conditions. However, because of the motor design, a dip in the power supply voltage would drop the motor out of step and result in a stall. Control equipment was then made available which would allow the motor to ride through the voltage dip and automatically re-synchronize, providing the motor had sufficient inherent torque to do this. It followed therefore that more and more engineers called for a pull-in torque of 100 percent plus. This not only permitted the motor to pull back into step after short voltage dips, but also allowed the pump to be started with its discharge valve opened. Thus full-automatic or remote control pumping plant operation with synchronous drive became accepted as a reliable and stable prime-mover.

The amount of pull-in torque over 100 percent, that should be specified, depends on possible variation in line voltage. As previously stated, the pull-in torque varies as the square of the voltage applied. Obviously, suffi-

cient torque must be built into the motor to assure its bringing the pump up to synchronous speed even if the normal line voltage should not be quite up to full value.

In many instances centrifugal pumps are in continuous service for months at a time. It follows that a gain in efficiency, to reduce the kilowatt hours consumed, may have considerable value when figured over the expected life of the installation. Higher than normal efficiencies can be obtained, at increased motor costs. Where electrical energy rates are high, and the pump in fairly continuous operation, the possibilities of getting a good financial return on an extra investment in higher than normal motor efficiencies should be investigated.

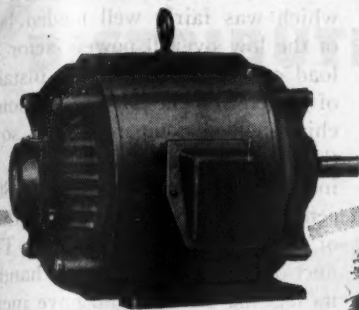
Earlier in this article, we discussed possible low torques and starting current on a synchronous motor driving a generator. If continuity of service is an essential, with the motor riding through voltage dips, it should be realized that sufficient pull-in torque (over 100 percent) must be incorporated in the synchronous motor to permit it to re-synchronize while still driving its load. That is, the re-synchronization problem for a synchronous motor-generator set is exactly the same as it is on a pump drive.

The use of centrifugal compressors in the air conditioning field has become wide spread in recent years. A 1200 RPM synchronous motor, connected to the higher speed compressor through a step up gear, is generally used. The required torques of this drive are very similar to the centrifugal pump application.

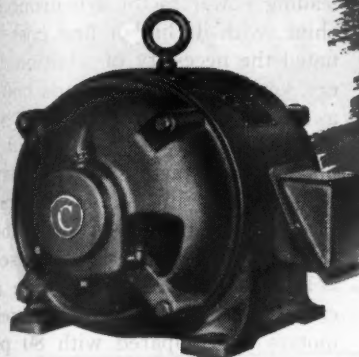
In fact, a high percentage of high-speed synchronous motors drive centrifugal machines, pumps, fans or blowers, or compressors. The first crude type of centrifugal pump built in the country was manufactured about 125 years ago. As a centrifugal machine is inherently a high speed machine there was no suitable prime-mover available. Thus most development in centrifugal pumps has been in the last 30 or 35 years since the use of electric motors has become commonplace. The synchronous motor filled a real need as the prime-mover for this field, in most of the larger installations where the horsepower required was appreciable.

The necessity for purchasing a synchronous motor is generally caused by a need for more water, more air, more refrigeration or more of some other item. Because of this, the manufacturer of the driven machine is generally the prime contractor including his machine

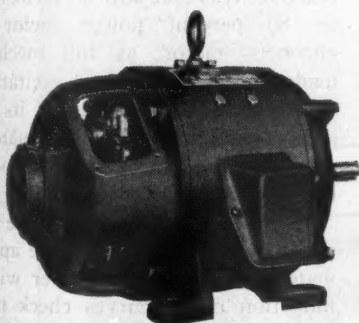
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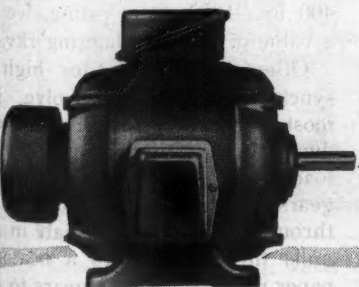
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together with the motor and control in the one contract. This is probably a logical approach, for if more water is needed, the pump manufacturer must supply the facts on what can be obtained from certain pumps. So it follows that the motor must be fitted to the requirements of the pump or compressor and not vice versa.

As a result of this situation, the ultimate user may be apt to put most consideration on the pump selection, ignoring to a large extent the selection of the motor and control. When it is realized that in a centrifugal pump and motor installation, for example, the motor and control may cost three or four times as much as the pump, one should be more inclined to give the electrical equipment the consideration it warrants. Further, thorough engineering study of the electrical installation should always be given. Some of the reasons for this are indicated in the following experience.

A large industrial plant recently purchased a centrifugal pump which required a 400 hp., 1800 rpm. motor to drive it. Engineering consideration was given to the use of three different motors, first, the 80 percent leading power factor synchronous; second, a unity power factor synchronous; and third, a squirrel cage induction.

The quotations of the motor manufacturers revealed the following guarantees:

Motor	% Full Load Efficiency	% Full Load Power Factor
.80 P.F. Synchronous	93.2	80 leading
1.00 P.F. Synchronous	94.2	Unity
Squirrel Cage	93.1	91 lagging

All efficiencies were quoted on an overall, or input-output basis, and thus could be directly compared. To compare the actual results of the different guarantees, the following formulae were used:

$$\text{Motor kw. input} = \frac{\text{HP.} \times 0.746}{\text{Efficiency}}$$

$$\text{Motor kva. input} = \frac{\text{Kilowatts}}{\text{Power Factor}}$$

From these calculations, two sides of the familiar power triangle are obtained, permitting determination of the actual lagging or leading reactive kva. We have, therefore

$$\text{Reactive kva.} = \sqrt{(\text{Total kva})^2 - (\text{kw})^2}$$

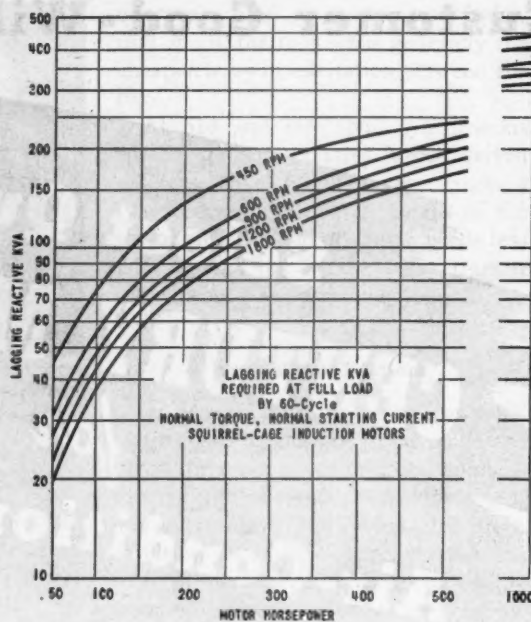


FIG. 8. Lagging reactive kva. of squirrel-cage motors can be approximated from curves above.

For the 80 per cent synchronous motor we have,

$$\text{Kw. input} = \frac{400 \times 0.746}{.932} = 320 \text{ kw.}$$

$$\text{Kva. input} = \frac{320}{.80} = 400 \text{ kva.}$$

$$\text{Rkva.} = \sqrt{(400)^2 - (320)^2} = 240 \text{ kva. leading.}$$

For the 1.00 P.F. synchronous motor we have,

$$\text{Kw. input} = \frac{400 \times 0.746}{.942} = 317 \text{ kw.}$$

With 1.00 P.F., the kva. and kw. are numerically equal and consequently there is no reactive kva.

For the squirrel cage motor we have,

$$\text{Kw. input} = \frac{400 \times 0.746}{.931} = 321 \text{ kw.}$$

$$\text{Kva. input} = \frac{321}{.91} = 353 \text{ kva.}$$

$$\text{Rkva.} = \sqrt{(353)^2 - (321)^2} = 147 \text{ kva. lagging.}$$

The analysis of the motor manufacturers' guarantee therefore becomes:

Motor	Kw. Input	Reactive Kva.
80% P.F. Synchronous	320	240 leading
1.00 P.F. Synchronous	317	0
Squirrel cage	321	147 lagging

The above figures show that the differences in kw. input was relatively small between the three types. This plant had a power factor condition that needed correction, and it was in this respect where the major difference resulted. The leading power factor synchronous machine had an advantage of 387 reactive kva. over the induction type (the sum of 240 plus 147).

The motor to be installed had as its source of energy, a 440 volt feeder which was fairly well loaded because of the low overall power factor of the load connected to it. The installation of the 80 percent p.f. synchronous machine helped compensate for some of the lagging reactive kva. The actual increase in current using the 80 percent p.f. motor obviated consideration of additional feeder capacity. The induction motor, on the other hand, with its lagging rkva, would have increased the current on the feeder beyond its operating capacity.

It was therefore determined that the leading power factor synchronous machine, with its higher first cost, eliminated the necessity of additional feeders, kept down the kilowatts consumed as losses in the feeder copper to a minimum, and gave an improvement in the plant power factor which was compensated for in the power company rate. The economics left no doubt as to the type of motor to be purchased.

For similar analyses on the differences in reactive kva. of squirrel cage motors as compared with 80 percent leading power factor synchronous machines, there is a useful "rule of thumb."

The numerical value of the leading reactive kva. that will be furnished by an 80 percent power factor synchronous motor, at full mechanical load, with full-load rated excitation, is approximately 60 percent of its horse power rating. The approximate lagging reactive kva. of cage motors can be read from the curves in Fig. 8.

For the problem solved above by the use of the power triangle, the approximate rule of thumb together with the induction motor curves check the results obtained and are useful for quick comparisons. On this specific problem, 60 percent of 400 gives us the 240 leading reactive kva. From Fig. 8, for the 400 hp., 1800 rpm., rating, we obtain a value of 140 plus lagging rkva.

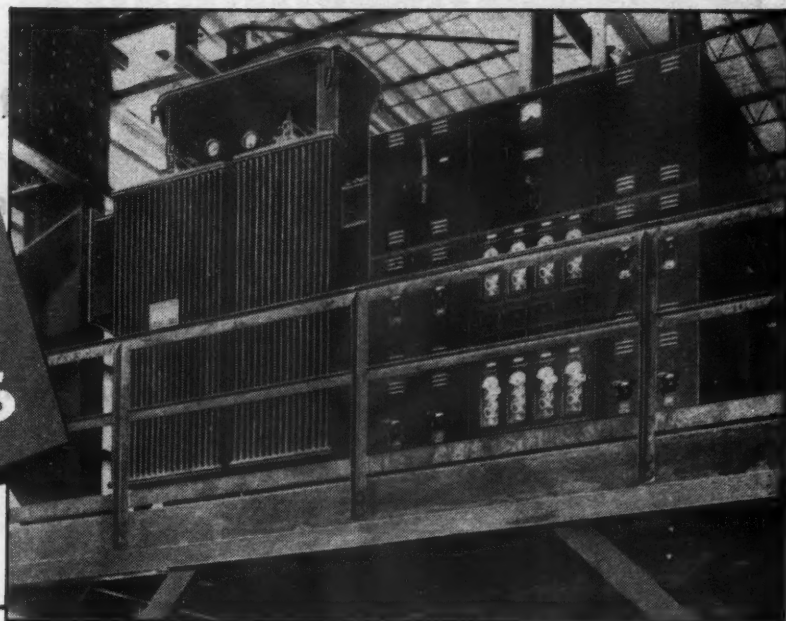
Other applications for high speed synchronous motors involve, in the most part, high torque requirements due to heavy friction and high inertia loads. A motor connected through gears to a tube mill in a cement plant; through belts to a line shaft in a flour mill; through belts to a beater in a paper mill; or through gears to a Banbury Mixer in a rubber mill, indicates several applications.

The next article will discuss the application of low speed synchronous motors. The application of synchronous motors running 450 rpm. or slower offers many advantages that cannot be obtained in any other type of motor.

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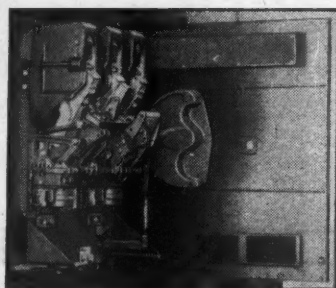
Improves performance of motors and lights. Inherent linedrop is avoided by eliminating long low-voltage feeders.

Saving of copper in connecting cables. Locating the transformer near the load allows the use of

shorter and smaller cables over a great part of the distance the power must travel.

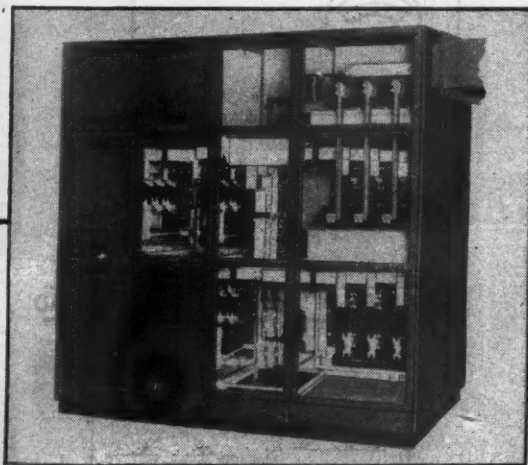
Low maintenance expense. The complete enclosing of the buses and other equipment practically eliminates cleaning and dust problems and assures safety against contact with live parts.

Provides flexibility to meet future conditions. Can be installed indoors without the use of expensive fireproof vaults.



Drawout Circuit-Breakers
—one of the types furnished

Drawout circuit-breakers, illustrated top left, are provided with a test position in which the main circuit-breaker terminals are isolated from the bus and feeder circuits. In this position the breaker-control circuits are still connected, permitting test operation of the breaker. Lower left is a rear view of the switch gear equipment; some of the panels on the switchboard have been removed to show bus bars, connections, and equipment. Solid construction is used throughout.



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DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index.

G-6

Instrument Connections

FREQUENCY METER

Frequency meters are connected as are voltmeters (see data sheet G-3). Built for use on 110/120 volt circuits, they should not be used on voltages greater than 150 volts. Above

150 volts, a variable-voltage autotransformer or a potential transformer should be used. Resistance multipliers must not be used.

D.C. MEASUREMENTS

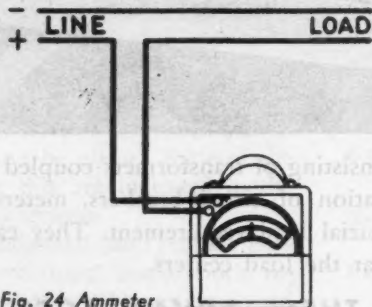


Fig. 24 Ammeter

AMMETER (Left)

If one side of the line is grounded, ammeters should be connected to that side.

MILLIVOLTMETER (Right)

Shunts are used with millivoltmeters to measure large current values. If the instrument reads backwards, reverse the instrument leads.

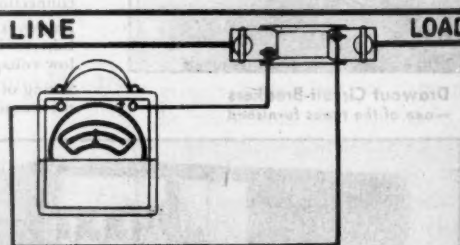


FIG. 25 Millivoltmeter and shunt for measuring current

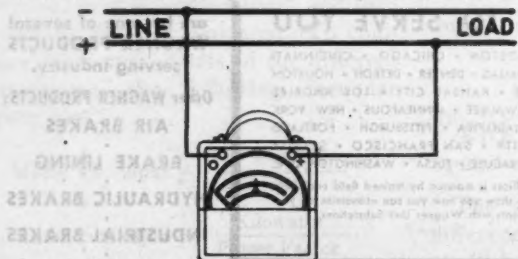


Fig. 26 Voltmeter

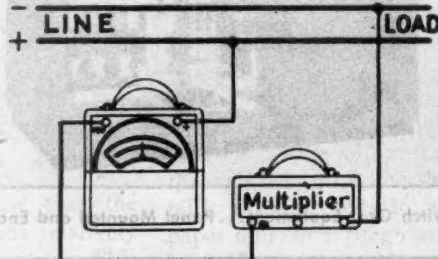


FIG. 27 Voltmeter and multiplier

VOLTMETER

Always connect a voltmeter across the load—never in series.

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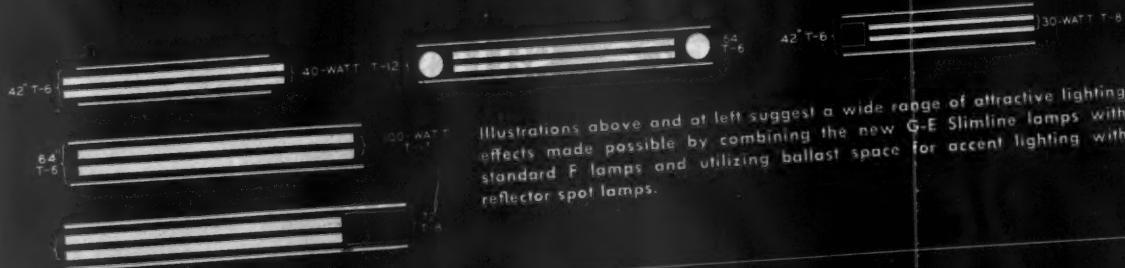
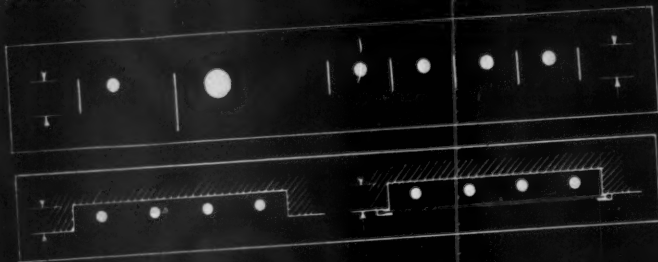


practical facts

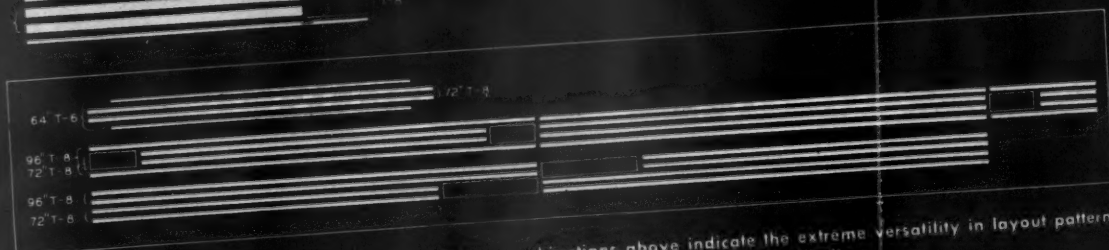


Above: Shows how the long slim lamps provide maximum lengths of uninterrupted lines for continuous fixtures or cove lighting.

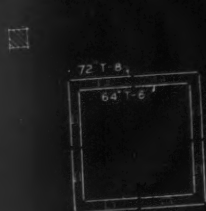
Right: These two sectional views illustrate minimum space requirements of the G-E Slimline. Top view compares the new lamps with standard G-E Mazda F lamps in the same shielding. Second view shows two recessed panel sections.



Illustrations above and at left suggest a wide range of attractive lighting effects made possible by combining the new G-E Slimline lamps with standard F lamps and utilizing ballast space for accent lighting with reflector spot lamps.



Various combinations above indicate the extreme versatility in layout patterns for long lines of light afforded by the G-E Slimline.



Above: Illustrates how the "custom" treatment of various sized areas can be achieved with G-E Slimline lamps.



Comparative views above show how the long slim lamps permit minimum dimensions for shelf lighting, cornices, coves or case tops. View at right above demonstrates how control of light is facilitated for show windows and displays.

G-E SLIMLINE MAZDA FLUORESCENT LAMPS

Lamp	Nominal Length* (Inches)	Max. Over-all Length of Lamp (Inches)	Bulb**	Current (Milliamperes)	Lumens (Approx.)
42T8	42	40	T-8	100	900
64T8	64	62	T-8	200	1400
72T8	72	70	T-8	100	1400
96T8	96	94	T-8	200	2150
				100	1400
				200	2350
				100	1950
				200	3300

* Nominal length includes one lamp plus two multiple sockets. When series sockets are available, the increase in over-all length will be announced.

** T-8 is 3/4" outside diameter (approx.)
T-8 is 1" outside diameter (approx.)

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G-E Slimline Fluorescent lamps*

A RECENT announcement presented the latest achievement of General Electric's lamp research—The new G-E SLIMLINE Mazda Fluorescent Lamps! These four long, slim G-E fluorescent lamps—up to eight feet in length—provide an extremely versatile and flexible light source for countless lighting applications.

To keep the lighting industry fully informed on new light sources, to facilitate design and planning, and to meet the needs of expanding lighting markets . . . complete information on the G-E SLIMLINE has been presented below. Suggested ideas for new lighting installations are shown at left.

UNIQUE FEATURES

1. Smaller diameter and longer length for slim lines of light.
2. High degree of flexibility in brightness values and lumen output is possible through operation of lamps over a variable range of wattages and current values—from 100 to 200 milliamperes.
3. Instant starting without starters.
4. Operation singly, in multiple or in series.

HIGHER EFFICIENCY

1. Initial light output—average of 60 lumens per watt.
2. For a given color, the longest lamp is 25% more efficient than any type or size of fluorescent lamps heretofore available from any source.
3. Minimum dark space at the ends.

IMPROVED DESIGN

1. Four different lengths—42", 64", 72" and 96"—for general illumination, concealed lighting, and all types of special applications.
2. Single pin base makes possible a safe design of lamp and socket for multiple operation.
3. Reduced cross-sectional area—approximately half the diameter of standard G-E Mazda F lamps.
4. New cathode developed especially for G-E Slimline Lamps results in long lamp life.

AVAILABILITY

1. Limited quantities of sample lamps in the 42" and 64" lengths, white only are now available. Other sizes will be available later.
2. Quantity production will proceed as soon as conditions permit.

*NEW G-E SLIMLINE PRICES JUST ANNOUNCED

42T6-\$1.55; 64T6-\$1.75;

72T8-\$2.00; 96T8-\$2.70.

These prices subject to taxes.

G-E MAZDA LAMPS

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Hear the G-E radio programs: "The G-E All-Girl Orchestra", Sunday 10 p. m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty", Monday through Friday 4:00 p. m. EWT, CBS.

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

READER'S QUIZ

BUS-DUCT FAULTS

QUESTION 156—We have a busway 500 feet long; that is metal case with busbar conductor inside, all sealed in and the case grounded. This developed a fault about two-thirds of the way from the supply end and burned off the whole busway. Now what caused this trouble? We believe it was something like a faulty insulator, loose connection, or a piece of loose metal in the busway that would cause a ground or short circuit.

This busway is 400 ampere, 3 phase, 480 volt. We were informed by an engineer that this was not uncommon and was probably caused by static. His explanation was that the busbar became highly charged with static, jumped across the insulator to the grounded metal casing, and the 480 volt current followed the arc path to ground. There is a great deal of static near this busway. In an effort to stop this trouble, a high resistance leak was put on each busbar to ground of about 10 watts each. This is supposed to drain off any static that might otherwise accumulate. I would like very much to know if other ELECTRICAL CONTRACTING readers have had or heard of similar experiences and what was done to remedy the situation.—W.L.C.

ANSWER 156—We had a similar experience in our plant, but the busway did not burn completely off. However, when switches were installed on our bus duct distribution system, the current would follow the arc and throw the breaker out of service. This busway is 600 ampere 3 phase 480 volt. It happened about five times. In an effort to stop the trouble, a high-resistance resistor was put on each busbar to ground of about 5 watts each. There is now a set of resistors at the end of each section of busway in the entire plant. This completely remedied our trouble.—R.D.R.

ANSWER 156—This has happened very frequently for us—sometimes blowing the switches off the busway.

It is caused by building up static electricity due to friction of machines, belts, etc., which charges the busbars in the busway until the insulation breaks down.

A spark, due to static electric charge, will jump from one busbar to another or to ground, providing a path for the 480 volts to follow causing a short circuit. This will happen at the weakest place, or at a heavily loaded switch on the busway which may cause an arc when opened or closed, permitting the 480 volts to jump across. This may be taken care of by installing a 17,000 ohm, 10 watt resistor from each busbar to ground.

Resistors for this purpose are made to fit in a 30 amp, 480 volt switch in place of the fuses.—E.W.N.

CURRENT MEASUREMENT

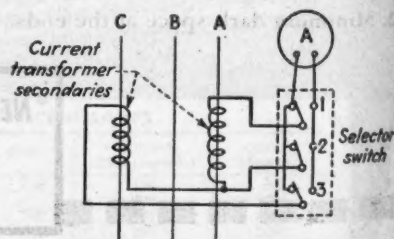
QUESTION 157—We have been connecting up a 117-volt, a-c lighting switchboard and would like to know from where the ammeter reading for phase B is obtained. The connections at the busbars are like this: phase A has a current transformer for its ammeter reading, phase C has the same. But there are no transformer connections that enable you to get a reading on phase B. Yet the selector switch on the front of the board selects a reading for each phase on the ammeter.—R.F.K.

ANSWER 157—The secondaries of the two current transformers which you mention are connected up in open delta; that is to say, one end of each secondary winding is connected together and a wire from this junction is brought to your selector switch together with the wires from the open

ends of the delta-connected secondaries. This now gives an opportunity to measure the currents in each of the three phases. Phase A will be read across the secondary of the current transformer in phase A wire; phase C will be read across the secondary of the current transformer in phase C wire; and phase B will be read across the ends of the delta connected secondaries.—W.B.M.

ANSWER 157—The reason it is possible to read the current in phase B with current transformers in phases A and C only, is that these transformers are connected in open delta. By the use of a proper selector switch it is possible to connect an ammeter to measure the current in any one phase.

Referring to the diagram, it can be seen that current transformers are connected in phases A and C and that they have a common connection which makes them open delta connected. It will be seen that with the selector switch as shown, the secondaries are short circuited which is the way they should be when not in use. When contact No. 1 is closed the ammeter is in series with the secondary of phase A thus measuring the current in that phase. When contact No. 2 is closed, the ammeter is in series with the common connection of the transformer secondaries, thus measuring the cur-



rent in phase B. When contact No. 3 is closed, the ammeter is in series with phase C, measuring the current in that phase.—P.N.

ANSWER 157—In a three-phase system, the current in any phase must always equal the vectorial sum of the currents in the other two phases. To measure the current in phase B, both phase A and phase C are connected

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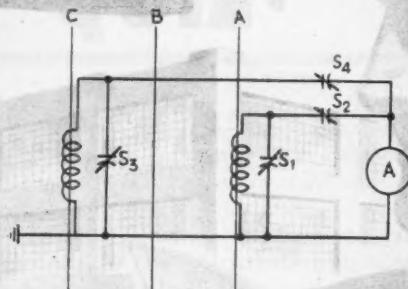
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to the ammeter. The reading will be the value of the phase B current.

The accompanying diagram shows the usual connections for an ammeter transfer switch for a two current-transformer installation for a three-phase system arranged to read the current in any of the three phases. The transfer switch incorporates contacts S1, S2, S3 and S4. To read phase A, contacts S2 and S3 are closed, thus



connecting transformer A to the ammeter and shorting transformer C. For phase C, likewise contacts S1 and S4 are closed. Closing contacts S2 and S4 place the two current transformer secondary windings in parallel. The meter will read the vectorial sum of the two transformers, this being the current in phase B.—L.R.B.

ANSWER 157—In any three phase, three wire circuit the current in any one wire is the vector sum of the current in the other two wires. A little reflection will show that this must be the case, since all the current going out from the generator in one wire must return through the other two.

Since this is the case, the ammeter reading for phase B is obtained by connecting in parallel the secondaries of the current transformers on phases A and C. The current passing through phase B ammeter is then the vector sum of the currents in phases A and C, hence the same as the actual current in phase B.—B. F. T.

ANSWER 157—At any point in an electrical circuit, the current into that point must equal the current leaving. In a three phase circuit, the current in phase B can be derived from the measured values in the other two phases if magnitudes and angular displacements are known.

Fig. 1 shows a vector diagram of a three phase circuit having balanced voltages, but unbalanced current and a different phase angle in each leg. (This diagram is based on the circuit shown in Fig. 2.) It will be noticed that the vector representing the current in phase B is equal and opposite to the sum of the vectors representing the current in phases A and C.

For clarity, three ammeters are shown in Fig. 2. A study of the dia-

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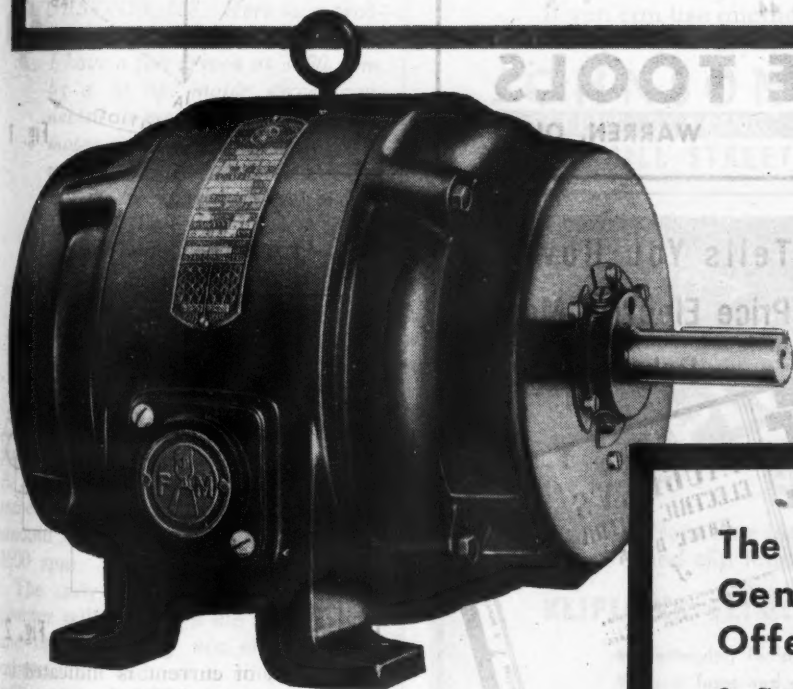
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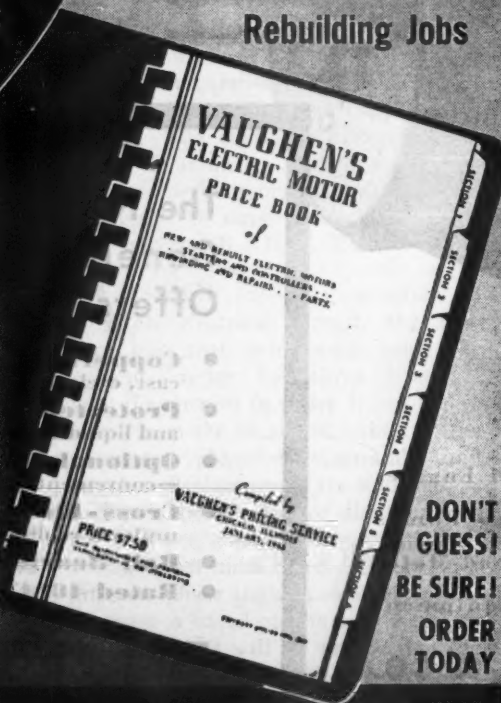
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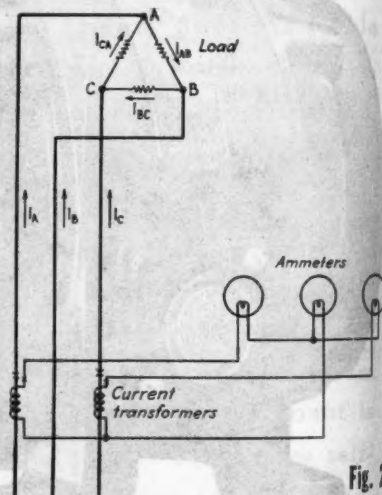
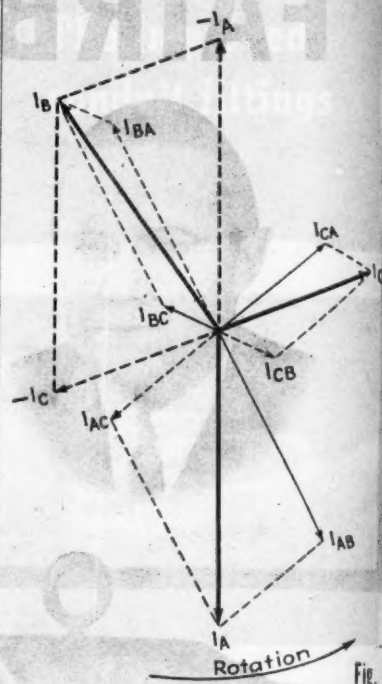


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gram will show that the middle instrument reads the vector sum of the other two. To understand the use of only one ammeter and a selector switch, R. F. K. should trace the source of current in any one of the ammeters shown after the other two meters have been short-circuited.

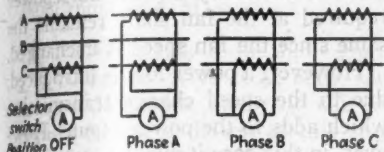


Direction of current is indicated in Fig. 2 to aid in visualizing the construction of Fig. 1. The double subscript notation on Fig. 1 indicates the flow of current. For instance I_{AB} is the current flowing from junction A to junction B. This assumption is made as a basis for convenient solution. I_{BA} would be I_{AB} reversed, or in other words, would indicate current flow in the direction from B to A—L.E.B.

ANSWER 157—The circuit connections for measuring the current under the conditions of the question are made by means of a selector switch designed for this purpose. The resulting circuits of the different set-

tings made by this selector switch are shown in the diagram.

You will notice that the current transformer secondary windings are never opened. Phases A and C are read through their respective current transformers. Phase B is read through both current transformers since the value of current in phase B is always



equal to the vector sum of the values of current in phases A and C. Any change of current in phase B will result in a change of current in one or both of the other phases, or vice versa. Consequently, two meters are sufficient for accurate measurement.—S.S.P.

FAN DRIVE RATINGS

QUESTION 158. Here is a problem that came up the other day. I have a fan driven at 3600 rpm. by a 50 hp. motor direct connected to motor shaft. What hp. motor at 1800 synchronous speed will be required to drive this fan at 3600 rpm. using proper counter shaft and belting to increase the speed?

Does the speed of driven or driving apparatus have anything to do with hp., rating of such equipment?—S.M.K.

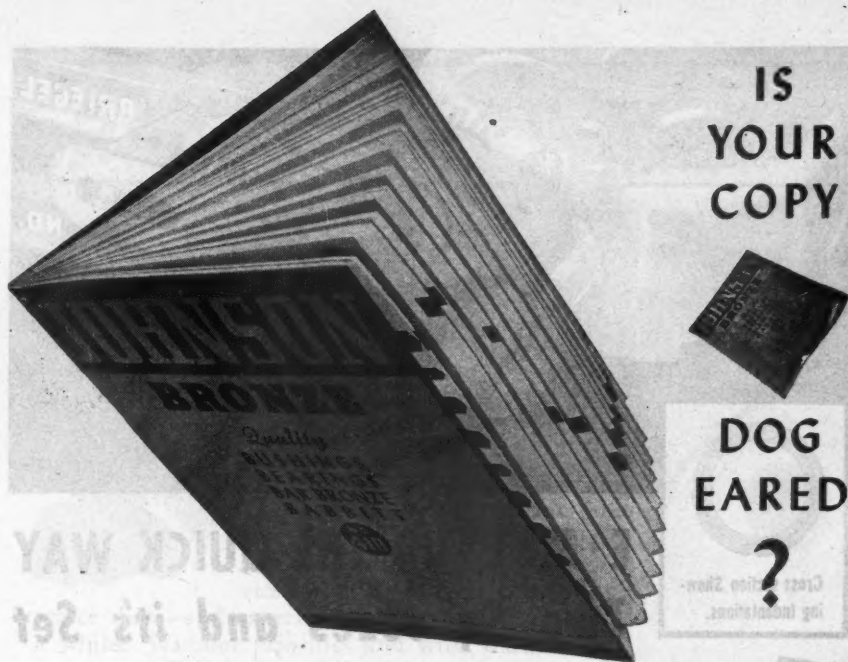
ANSWER 158. The rated speed of a motor and its rated horsepower are features built into the motor. A 50 hp. motor at 1800 rpm. has the same horsepower and will do the same amount of work as a 50 hp. motor at 3600 rpm.

The only extra loss you will encounter will be due to the countershaft and belting. Why not eliminate the countershaft and use a simple 2 to 1 pulley ratio with V belts, being careful to have the small pulley large enough to avoid slippage?

With this arrangement, the extra loss will become a negligible factor and the 1800 rpm. motor will perform equally as well as the 3600 rpm. motor with perhaps a slight decrease in power factor.—S.S.P.

ANSWER 158. The horsepower for fans and blowers, if the area of the outlet remains unchanged, varies directly as the cube of the speed.

In the first case the speed of the fan is 3600 rpm., direct connected to the 50 hp. motor shaft. Therefore, in conformity with the mechanical law



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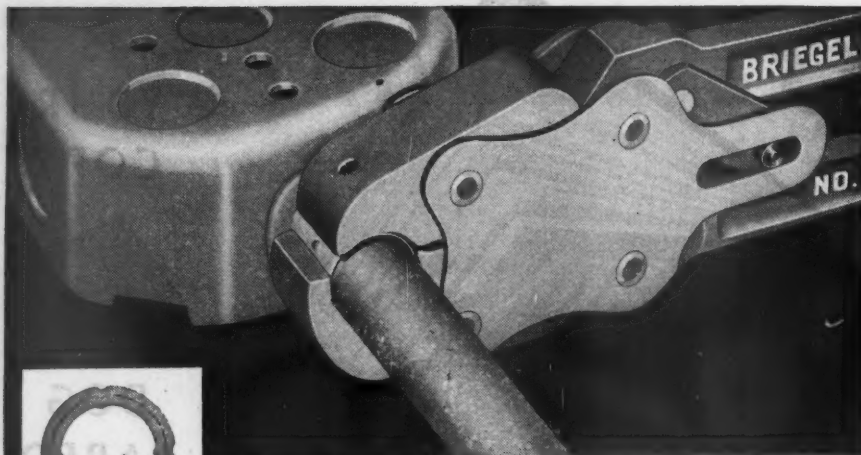
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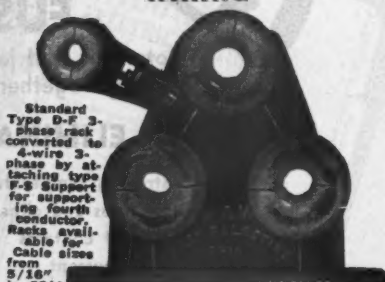
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stated, the following proportion holds:

$$HP_1 = \frac{S_1^3 HP_2}{S_2^3} = \frac{3600^3 \times 50}{1800^3} = 50 \text{ HP.}$$

S_1 and S_2 = fan speeds

HP_1 and HP_2 = fan shaft-horse powers

If an 1800 rpm. motor were used to drive the fan at 3600 rpm., a 2:1 ratio drive is necessary but the horsepower required at the fan shaft remains the same since the fan speed is unchanged.

However, a power loss is introduced, due to the speed change transmission which adds to the power input. However, in this case it may be regarded as negligible for practical purposes.—R.J.M.

ANSWER 158. The power required to drive a load, either by direct drive or through counter shaft or gears, is constant at any part of the drive. The torque, however, is inversely proportional to the speed in different parts of the drive. The horsepower rating of the direct connected motor driving the fan is determined by the fan speed. When countershaft and belting is used in the drive to utilize an 1800 rpm. motor, the losses caused by such auxiliary equipment must be added to the power required to drive the fan at 3600 rpm.

If a 4-pole induction motor is used for the belt drive, the drop in fan speed below 3600 rpm., due to the slip of the motor and drive with a 1 to 2 ratio drive, may lower the fan output to such an extent as to compensate for the added losses caused by the belt drive.—R.G.C.

ANSWER 158. The horsepower requirements of the driven apparatus will remain the same as long as the driven apparatus is driven at the same speed. This is true regardless of the speed of the motor. If the speed of the fan, however, is reduced, then the horsepower requirements will be reduced. In calculating fan loads, the horsepower requirements vary as the cube of the speed. If the fan speed is reduced to 1800 rpm., then the speed has been cut in half and the horsepower required will be about one-eighth the original 50 horsepower or, six and one-quarter horsepower.

But for a given fan speed, the horsepower requirements of the motor will be the same.—L.R.B.

ANSWER 158. The horsepower required to drive a fan is very definitely governed by the fan speed. There are certain fundamental laws which can be applied to all types of fans in order to determine the effect of changes in operation. These laws are as follows:

1. The air capacity varies directly as the fan speed.

2. The pressure (static, velocity, and total) varies as the square of the fan speed.

3. The power demand varies as the cube of the fan speed.

Since there is to be no change in the speed of the fan itself, there will be no change in the horsepower of the driving motor, whether it be 3600 rpm. or 1800 rpm.—R.L.M.

ANSWER 158. If the fan requires 50 hp. to drive it at 3600 rpm., using a 3600 rpm. motor, it will still require 50 hp. if driven at this speed when using a belted 1200 rpm. or 900 rpm. or 600 rpm. motor or what have you. A slower speed motor will be physically larger requiring larger mounting base; also there will be some friction losses in the belt drive but these losses will be so small that they should not affect the size of the motor. Motors are usually underloaded rather than overloaded, and even if the fan actually requires full 50 hp. from the 3600 rpm. motor, most standard open 40" continuous rated motors have what is called a "service" factor of 15 percent which means that when operated at their rated voltage and frequency they will carry 1.15 times their rated load with possible slight differences in efficiency and power factor from those at rated load.—R.F.E.

UNSTABLE GENERATOR OPERATION

QUESTION 159—I was once called on a boat to find out what the trouble was with a compound wound dynamo. This dynamo was running all right until it was stopped to make repairs on its prime mover. When the dynamo was again started up the voltage would build up all right, but when load was applied the voltage would collapse on the dynamo.

The first thing I did was to reverse the series field, this did no good, so I connected it back the way it was at first, then reversed the shunt field. When this was done, the voltage would not build up at all. So I connected it back the way it was in the beginning. Then I passed current from another machine through the shunt field coils. This didn't remedy it either. Next I shifted the brushes. This had the effect of raising and lowering the voltage. By that time the boat was ready to sail and I had to leave the job without finding the trouble.

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Don't wait!!! Many Superior customers are anticipating and ordering now for post-victory use. Materials may be scarce then—and experienced labor, too—for quite a while. Without priorities and with wartime restrictions still lingering, deliveries may be slow... Better place your orders right away. If special conditions call for special study on our part, all the more reason for moving fast. The Superior Research Department is very busy, but not too busy to investigate your needs thoroughly. Why not write now and give us time to do you a good job?

Get our Bulletin "C"



SUPERIOR CARBON BRUSHES



SUPERIOR CARBON PRODUCTS, INC.
9113 GEORGE AVE.
CLEVELAND 5, OHIO

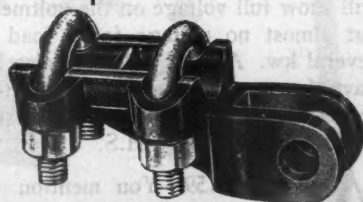
"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION



Clamps available in three sizes for Cable diameters of 1/0 to 1,500,000 cm.

EFFICIENCY CABLE STRAIN-CLAMP

Stands Direct Pull of over 17,000 lbs. before cable slips!



By actual test, the EFFICIENCY Cable Strain Clamp will withstand a direct pull of over 17,000 pounds without permitting the cable to slip. This powerful grip results from the EFFICIENCY Clamp's "H" design, incorporating a high ridge across the center of the cable channel and a U-bolt at each end.

Adaptability to all requirements is provided in the EFFICIENCY Clamp's alternate construction... which may be clevis or eye, according to your requirements. Both styles are furnished for A.C. or D.C. service.

Write today for your copy of EFFICIENCY Catalog No. 39A... contains complete construction and application data on all EFFICIENCY Devices.

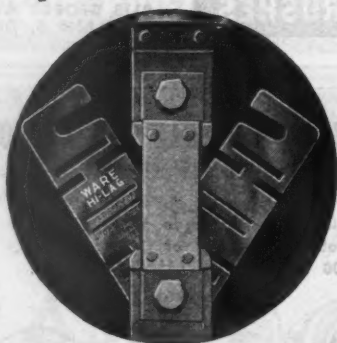
Efficiency
ELECTRIC AND MANUFACTURING CO.

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT WIRE AND CABLE SUSPENSION



WARE HI-LAG

Keep Motors Humming



KNIFE-BLADE ASSEMBLY
For Low Contact Resistance
Non Heating Wide Surface Area
and Quick Link Renewal



100% Quality

APPROVED BY UNDERWRITERS

WARE BROTHERS

4410 W. Lake St. Chicago 24, Ill.

WARE
Renewable
HI-LAG FUSES

I would like to know if any of the readers of ELECTRICAL CONTRACTING have had similar trouble and if so how they remedied it?—H.J.A.

ANSWER 159—My similar experience was with a light plant on a dredging barge. The operator assured me he was getting voltage at the generator terminals, but still his lights would not burn. I checked connections, both internal and external. We started the machine, but the lights remained out. A lamp would not burn at the terminals, indicating no terminal voltage. By megger test I found it read zero to ground on the fields. The fields were removed and thoroughly dried in a lamp oven which remedied the situation completely. I have found that machines on boats are subject to moisture such as splashing, spray or fog. When running, the windings warm up considerably; during shutdown while cooling, the moisture is drawn into the windings unless they are kept well treated with a good moisture-proof insulating varnish.—W.R.E.

ANSWER 159—Shipboard installations are notorious for dampness. The first thing we did in a similar experience was to measure the insulation resistance which proved fair.

Next was to test shunt field resistance which proved fair.

Next was to test series field resistance which showed normal.

Then a check was made for loose and dirty connections. A soldered point was found between two shunt field coils which did not look right. After this was cleaned, resoldered and taped, the machine picked up the load without any trouble whatsoever. Apparently, the resistance of this joint was high enough to weaken the field to a point where it could not maintain voltage.—A.C.L.

ANSWER 159—Such a condition could exist under several conditions. For instance, a high resistance in the armature circuit such as a 60 watt lamp in place of a fuse. This will show full voltage on the voltmeter but almost no voltage for a load of several kw. A weak field will also behave the same way, and can be caused by bad field coils, a bad field rheostat, or bad field wiring.—H.S.

ANSWER 159—You mention using separate excitation and also the fact that the ship left port with this generator out of commission. This indicates that there was at least one more generator on board. The other generator (or generators) would most likely be compound wound. Your trouble seems to indicate disturbance of

the compounding shunt, equalizer connection, or both. When you endeavored to have the machine pick up its load, did you parallel it, or was it then the only one in use? In the former case, check the two points mentioned above; otherwise check armature circuit for a weak connection by passing full load current through it from another machine. It is possible that the connection would be good enough to show normal voltage on no-load but fail to carry full load.—A.R.A.

Can you ANSWER these QUESTIONS?

QUESTION F7—We have a 100-kva diesel-generator delivering power at 2300 volts, 3-phase, 3-wire. Phase A feeds motors of $\frac{1}{2}$ to 5 hp., while phases B and C carry all the lighting and motors smaller than $\frac{1}{2}$ hp. Average phase loads are approximately balanced, but frequent starting of motors on phase A causes the generator to regulate badly, resulting in very ragged busbar voltages on all three phases. A vibrating-type generator voltage regulator has been purchased. To what phase should the leads of the controlling coil be connected and is there any better method of loading which would help relieve my bad voltage condition?—E.O.L.

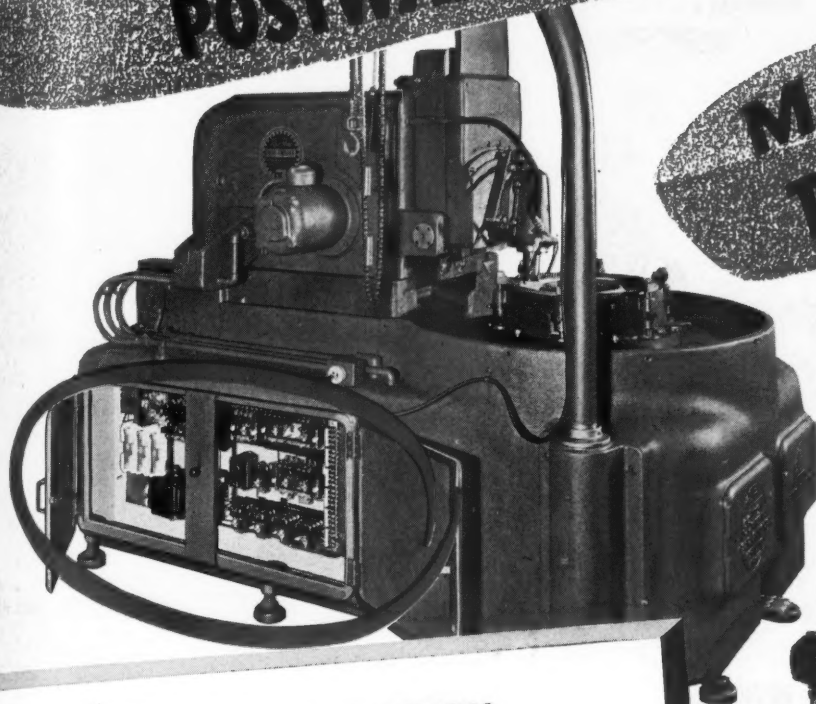
QUESTION G7—The ammeter on our switchboard is connected to only one phase of our three phase system. The meter is now in series with one of the main overload relays which are connected to the two current transformers on the main bus. How can we reconnect this meter to read the load on the other two phases?—J.J.L.

QUESTION H7—A very sudden and heavy overload was placed on two of our over-compounded motor generator sets operating in parallel. The circuit breaker went out and the polarity of one generator reversed as indicated on the switchboard voltmeter. Why did the polarity reverse and how can the equipment be protected against a reversal of polarity? They are 50 kw. machines and the individual breakers are set at 200 amperes with the main breaker at 400 amperes.—L.A.

QUESTION J7—We have installed in an Army Camp Laundry sixteen $1\frac{1}{2}$ horsepower squirrel cage induction motors, each of which is direct connected for exhaust fan duty. The motors are 220 volts, 3-phase, 60 cycle. They are supplied with 3-phase, 208 volts, 60 cycle current. Will the supplied voltage damage the motors and what effect will it have on the slip and torque of the motors.—G.R.G.

PLEASE SEND IN
YOUR ANSWERS BY FEBRUARY 1

POSTWAR TRENDS in MACHINE TOOL DESIGN



Broaching machine, made by National Broach & Machine Co., with Allen-Bradley built-in control panels and limit switches.

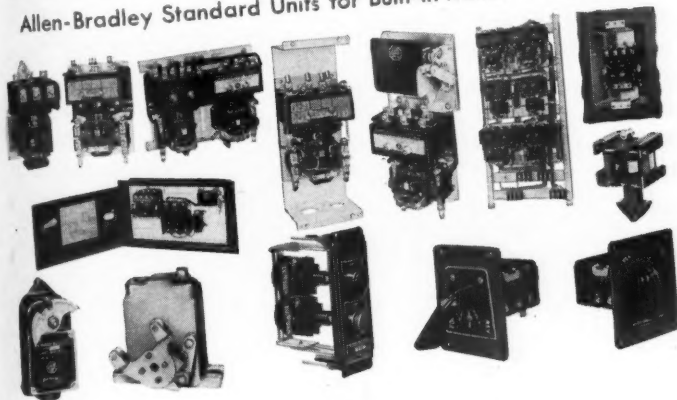
1st — STREAMLINED CONSTRUCTION 2nd — BUILT-IN MOTOR CONTROLS

Machines are being streamlined. Designers of postwar equipment are giving close attention to appearance. Utility, alone, is not enough!

That's why so many postwar machines will be equipped with "built-in" controls. Starters, contactors, relays, and disconnect switches... arranged on panels to provide the correct sequence operation... will be mounted within machine bases or columns.

Allen-Bradley standard units are ideal for built-in control applications. They are compact, long lived, and trouble-free. The silver alloy contacts require no service attention. See Sweet's 1944 Product Design File (Section 3B1) for 24-page Allen-Bradley catalog or send for bulletins.

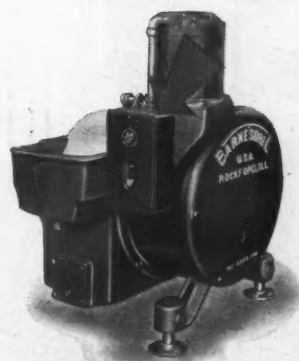
Allen-Bradley Standard Units for Built-in Motor Controls



ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

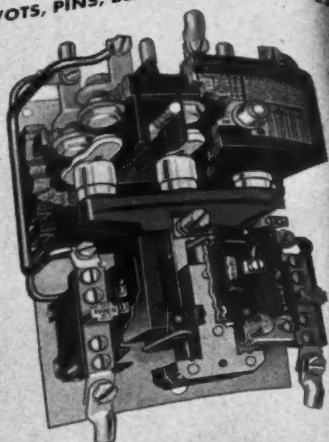


Bakewell radial drilling and tapping machine, now made by Warner-Swasey, equipped with Allen-Bradley built-in control panels.



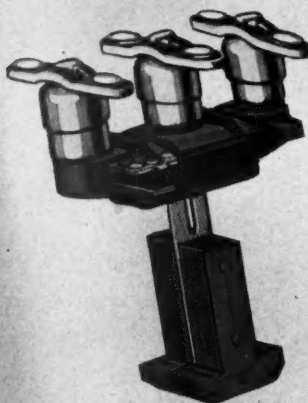
Coolant separator, designed by Barnes Drill Co., with built-in Allen-Bradley manual across-the-line starter.

NO PIVOTS, PINS, BEARINGS, OR HINGES



The simple magnetic plunger, shown above, is the only moving part in the Allen-Bradley solenoid starter. There are no pivots, no pins, nor bearings to stick; no hinges to corrode; no flexible jumpers to break.

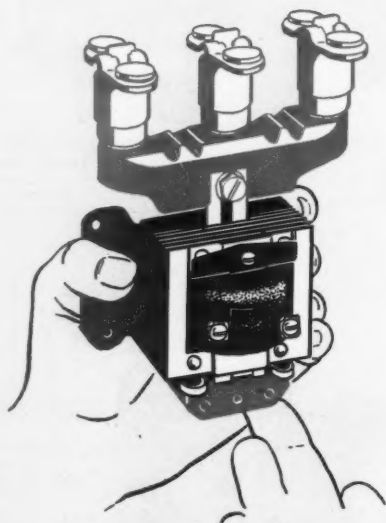
NO CONTACT MAINTENANCE



The patented Allen-Bradley double break, silver alloy contacts need no cleaning, filing, or dressing, because the oxides which form on them are good electrical conductors. Contact heating is prevented.

The Amazing Success Story of Allen-Bradley Solenoid Starters can be told in 4 words:

"Only one moving part"



The double break, movable contacts of the A-B solenoid starter are mounted on an insulated cross-bar which is attached to the simple magnetic plunger.

Every engineer knows...and every maintenance man agrees...that the greatest simplicity in design is the best assurance of trouble-free starter operation. Less parts mean less trouble.

Therefore, when a motor starting switch...like the Allen-Bradley solenoid starter...has *only one moving part*, it is not only the **SIMPLEST** but also the most trouble-free starter on the market.

The widespread preference of machinery builders for Allen-Bradley solenoid controls accounts for the dominant position of the Allen-Bradley line in recent market surveys. Machinery builders understand the value of a simple design, especially in severe service...so they specify Allen-Bradley solenoid control.

Allen-Bradley Company, 1316 S. Second St., Milwaukee 4, Wis.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL



QUALITY

It is interesting to note that the labor units applicable to wire pulling for the estimates illustrated vary from 6.0 to 8.0 man-hours per 1000 feet of wire (No. 12 being the size in each instance). This is due to the variation of distance between outlets in each job and the number of conductors per conduit. You will note that while the average number of wires per conduit in estimate "B" was greater than in "A", the shorter distance between outlets in "B" required a higher labor unit for wiring. Although the distance between outlets was practically the same in estimates "B" and "C", the smaller average number of wires per conduit in "C" necessitated a larger labor unit.

Now, let us assume that a "constant" unit per 1000 feet of No. 12 wire was used—as is the practice of many estimators. Assuming this "constant" as 7.5 man-hours per 1000 ft. for "short" pulls we have the following results: Estimate "A"—37.5 MH for pulling wire (30MH by using Table 1); 33.75 MH for estimate "B" (31.5 MH from use of the Table 1); 4.5 MH for estimate "C" (4.8 MH by using Table 1). It is evident that the use of a constant value for all conditions may lead to over-shooting the true labor in some cases and falling short in others.

Job Progress Check

It is frequently desirable to check the progress of the job, from the standpoint of labor, after the "rough-in" work is completed. This means estimating the amount of labor required to do the "trim" work, adding this to the labor already expended on the "roughing-in" and checking the total with the original estimated labor for the complete job. The estimating system presented in this and previous articles makes no specific division between "rough" and "trim" labor items at the time of the initial estimate. As mentioned before some of the so-called "trim" labor is included in the "conduit outlet" tables—such items as splices, taps and connections to wiring devices. For that reason the attendant Table 2 is presented giving the "trim" labor for outlets. This is *not to be used in making the original estimate*. It should be employed *only to make a quick check of the labor status* of the project after "roughing-in" has been completed. The sample check estimate in Fig. 1 illustrates the use of this table.

PORCELAIN ENAMELED



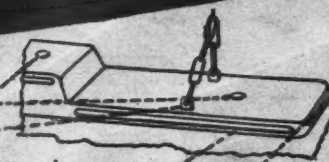
For quality, adaptability, and economy in shop and lighting, see the new King "Screw" fixture. It's a development in lighting with important exclusive features of design and construction that make it greater than that of most ordinary wall and ceiling fixtures. Write today for Brochure No. 100.

Knockouts for conduit mounting.

Ears for chain suspension.

Slide-grip hanger grooves for U-type hanger straps, permitting positioning of straps at almost any location along entire length of hood.

Knockouts in end for either a pull-switch or coupling for continuous runs.



See you in Chicago!

Look for our booth at the International Lighting Exposition in Chicago, April 17-22.

BRIGHT LIGHT REFLECTOR CO.

Maineapolis and Morgan Avenue - Franklin, N. H.

MODERN LIGHTING

COLD CATHODE IN A DRAFTING ROOM

Cold cathode tubing is the newest light source employed in the relighting of the drafting room of the Empire Engineering Company in Detroit, Michigan. The existing lighting system, utilizing two-lamp, 40-watt, industrial type fluorescent fixtures suspended two feet from the 9-ft., 6-in. ceiling on a 6-ft. by 8-ft. spacing provided an intensity of 30 foot-candles over the tables and an average of 18 foot-candles throughout the 42-ft. by 100 ft. room.

The new lighting, installed by Thomas A. Vanadia & Co., Detroit contractor, utilizes 6-ft. lengths of 18 mm., 60 milliamperes cold cathode tubing mounted exposed direct to the ceiling which is painted a flat white color. The tubes are installed in parallel lines on approximately 4-ft. centers to form a pattern of long "U" shaped lines of light.

Current for the tubes is furnished by 15,000-volt and 9,000-volt transformers; the former serving 65-ft. sections of tubing, and the latter 38-ft. sections. Transformers are mounted adjacent to the ceiling on the sides of the exposed beams in the room. The lighting is controlled in sections by wall-mounted toggle switches.

The bare tubing of this low bright-

ness light source does not appear to bother the draftsmen. The tubes are run at right angles to the length of the drafting tables so the engineers, when looking up, view the tubes along their length and not broadside. With an initial installed intensity of 30 foot-candles, the new lighting now provides an average maintained intensity of 26 foot-candles of uniformly distributed illumination.

LIGHTING A PROPELLER TEST TUNNEL

Every airplane engine plant is equipped with a "prop house"—a tunnel in which engines are given a test with a propeller attached to the shaft. By doing this engineers are able to study the actions and reactions of the engine under various "prop" conditions. Actual performance specifications can be checked and determined.

The tunnel at Chrysler Corporation's Dodge-Chicago plant, where engines for the B-29 super-bomber are manufactured and tested, is 25-ft., 8-in. in diameter and more than 63 feet long. Lighting this area was somewhat of a problem. The greatest amount of light was needed at the point where the engine was bolted to its supporting



LIGHT IS CONCENTRATED at the mounting for B-29 engines in this propeller test house. Flush type incandescent units with special lenses provide 10 foot-candles at the engine. Similar units light the rest of the tunnel.

structure. A much smaller quantity of illumination was needed in the other sections of the tunnel.

As installed by the electrical contractors, the lighting system consists of 24 flush incandescent units equipped with optical lenses designed to cooperate with the polished aluminum reflector behind the 300-watt medium base lamp in each fixture. Each unit is enclosed in 13 $\frac{1}{2}$ -in. square metal box which is 10 $\frac{1}{2}$ -in. deep.

Since the greatest concentration of light is at the engine mounting, two circles of flush fixtures six feet apart (each with six units) were installed at this point (see diagram). The units directly in front of the engine are equipped with a 15 degree offset and a 3 $\frac{1}{2}$ -inch focus. All other units have no offset. Another circle of units (four fixtures) is located 15-ft., 9-in. behind the units immediately in back of the engine mounting. Two other groups of units (four fixtures per group) are spaced respectively 11 feet and 41 feet ahead of the units immediately in front of the engine mounting.

With this arrangement 10 foot-candles of illumination is concentrated at the engine mounting. Engineers thus have plenty of light all around the engine to facilitate mounting and unmounting the engine and propeller. Intensities in the rest of the tunnel area are sufficient for the task at hand.

In the control and instrument room



LOW BRIGHTNESS of the cold cathode light source permits this bare lamp installation in a drafting room without noticeable discomfort. Uniform average maintained intensity has been raised from 18 to 26 foot-candles.

it's easy to see when it's "Day-Brite"

How this man helps you make a profit

No—he's not on your payroll! But, he's making money for you because he's a booster for the quality that's easy to see when it's Day-Brite!

Whenever you put a Day-Brite fixture on the job, *it stays put!* The question of light is settled for a long, long time—because every Day-Brite unit is known to combine the highest degree of illumination effectiveness with mechanical design features that assure ease of installation, continuous trouble-free operation and quick accessibility for occasional maintenance and service.

The DAY-LINE, pictured above, is a heavy-duty industrial fixture, with porcelain enameled steel reflectors, for unit or continuous-run mounting with Day-Brite "Ice-Tong" Hangers... Get Bulletin F-77

Consult your nearest Day-Brite Engineering Representative



DAY-BRITE LIGHTING

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● Nationally distributed through all leading electrical supply houses

LOXON GRIPON

... guard against
breakage and theft!



**THE
NEW
LOXON**
No. 1427-A



**THE
NEW
GRIPON**
No. 1602-A

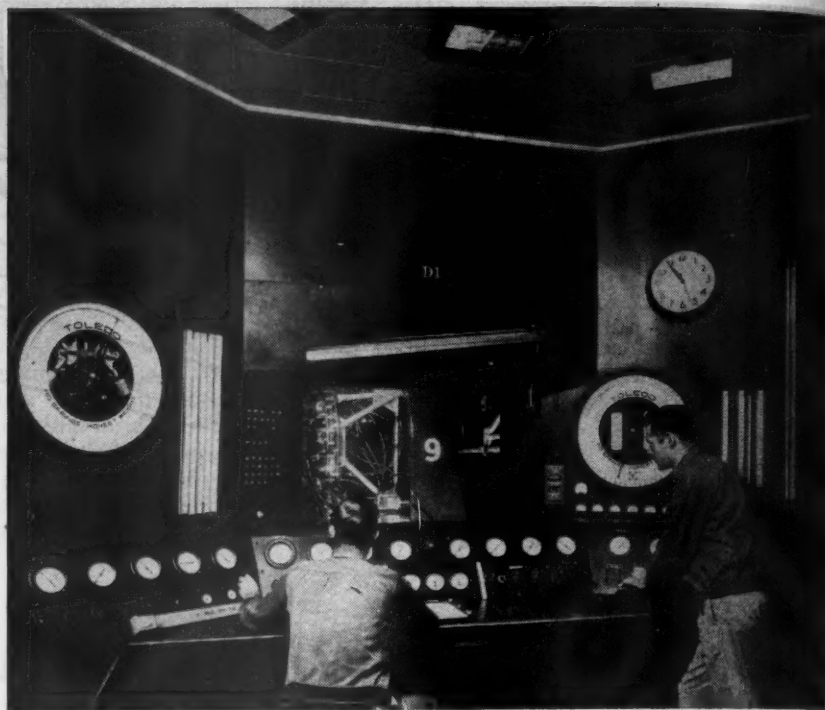


The McGILL LoXon Guard is your best assurance for protection against breakage and theft because it locks on with a key! However, where theft is a minor issue, the Gripion is fully as effective against breakage. The only difference in construction is that the key locking device on the LoXon is replaced by plain steel screws on the Gripion. New improvements have recently been made on these two guards:

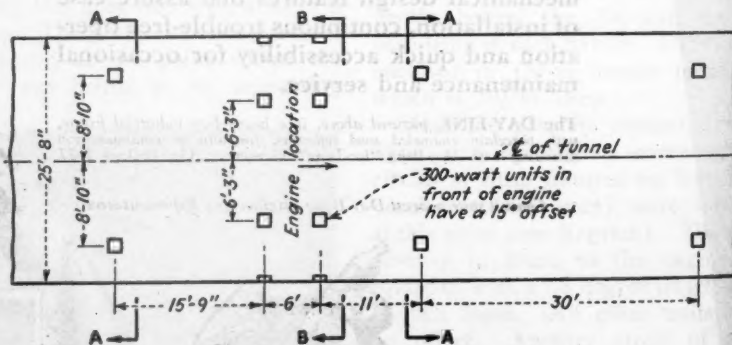
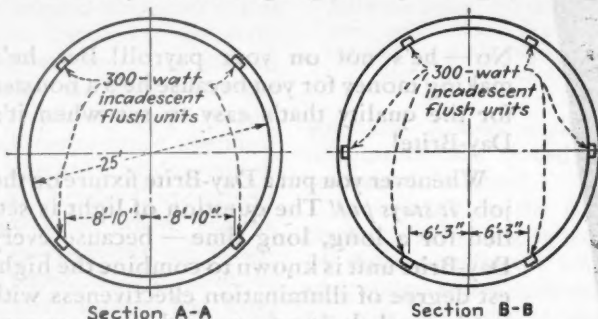
1. Shape has been changed to conform to new style lamps.
2. Heavier wire is used — No. 14 instead of No. 15.
3. Both LoXon and Gripion are available with or without reflectors.
4. There is NO increase in price — only increased value for the user!

**McGILL Products Can Be Secured
from Your Electrical Wholesaler.**

McGILL MANUFACTURING CO., Inc.
Electrical Division, VALPARAISO, IND.



CONTROL ROOM LIGHTING is similar to this found in the numerous test cells at the Dodge-Chicago plant. Flush incandescent units with prismatic lenses provide the necessary controlled lighting for easy reading of instrument dials.



Plan View of Propeller Test House
Note:— All units have a 300-watt medium base lamp with a polished aluminum reflector

LIGHTING LAYOUT for the propeller test house showing the location and spacing of the incandescent units. Note concentration of units at the engine mounting.

of the propeller test house, units of similar design and construction are equipped with prismatic lenses. These units are located directly over the instrument bench providing concentrated controlled illumination on the numerous dials.

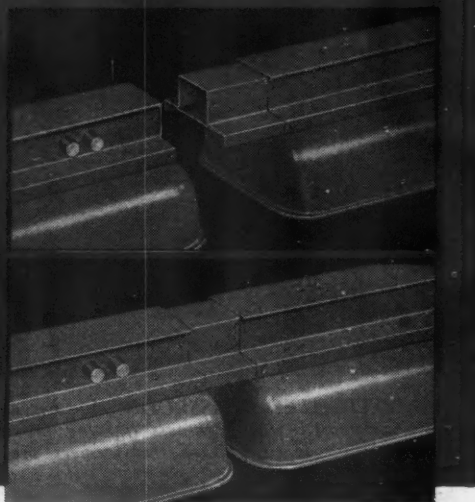
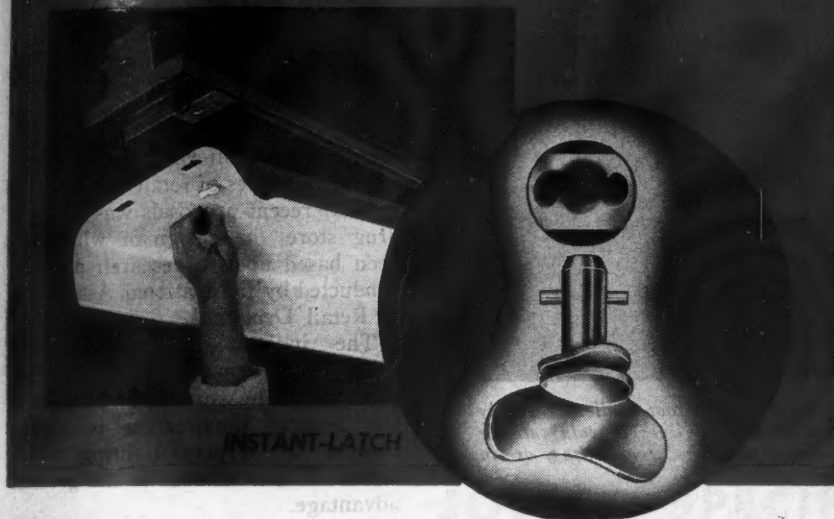
As may be noted in the diagram above the lighting units are arranged to light the engine mounting from above and below.

RELIGHTING CLASSROOMS WITH COLD CATHODE

The old 300-watt enclosing globe incandescent unit in the classroom of the Annunciation High School in Detroit, Mich., is no more. In its place is a system of exposed cold cathode tubing producing from 12 to 15 foot-candles of low glare, evenly distributed lighting.

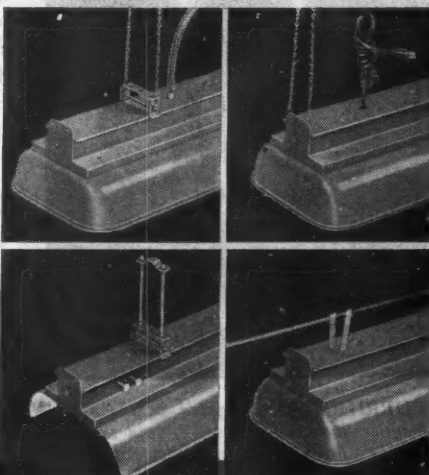
EASIER • FASTER

TO INSTALL, CLEAN and SERVICE NEW MITCHELITE ALL-STEEL FIXTURES



SIMPLE COUPLING
FOR CONTINUOUS ROW LIGHTING

EASY-FIT ACCESSORIES
FOR MOUNTING OR HANGING



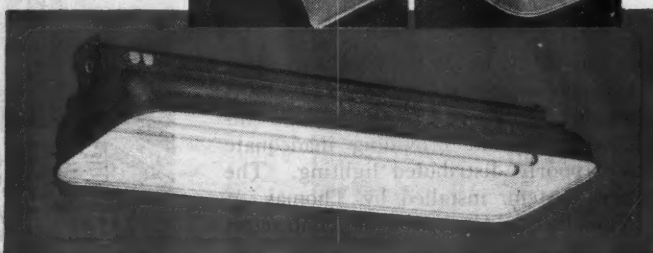
Mitchell design makes the difference! In a few seconds, you can attach or release the reflector . . . without use of tools. A quarter turn of Mitchell's new aircraft-type "Instant-Latch" does the trick.

Simplified channel design and easy-fit accessories provide for *every method of mounting or hanging*. New couplers quickly connect units in continuous rows. All removable parts of the fixture may readily be detached for service or replacement.

All this makes the new MITCHELITE All-Steel Industrial Fluorescent Fixtures today's outstanding value!



Open-End type, with choice of Baked Enamel or Porcelain Enamel, in 2-40, 3-40 and 100-watt models. ("Instant-Start" available on 2-40 watt units.)



One-Piece Closed-End type, with choice of Baked Enamel or Porcelain Enamel, in 2-40, 3-40 and 100-watt models. ("Instant-Start" available on 2-40 watt units.)



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RELIGHTED CLASSROOM now has approximately 15 foot-candles of evenly distributed, low-brightness lighting provided by parallel lines of cold cathode tubing. High voltage transformers are concealed above the ceiling or in cloak rooms.



CORRIDORS are lighted in the same manner with double lines of cold cathode tubing providing continuity of light around corners and ells.

The 20-ft. by 30-ft. classroom illustrated was formerly illuminated by a single 300-watt, enclosing globe incandescent unit providing inadequate and poorly distributed lighting. The new system, installed by Thomas A. Vanadia & Co., Detroit contractor, consists of a series of parallel lines of 20 mm., 60 ma., cold cathode tubing mounted on approximately 4-ft. centers on the 13-ft. ceiling to produce a long "U" shaped pattern of light lines. Tubing is in 6-ft. sections for easy replacement.

Current for the tubes is supplied by 15,000-volt transformers mounted above the ceilings at the back of the rooms, or mounted exposed on the ceilings of the cloak rooms. Control is by means

of a toggle switch at the door of each room.

With the ceilings and upper walls of each room painted a flat white, this low-brightness light source provides an even distribution of illumination at desk level. Further reduction of glare is accomplished by installing the tubing parallel to the rows of desks so the students, if they are prone to do any ceiling gazing, will look along the length of the tubes rather than broadside. No enclosing glass or control louvers are used.

INDIRECT LIGHTING FOR DRUG STORE

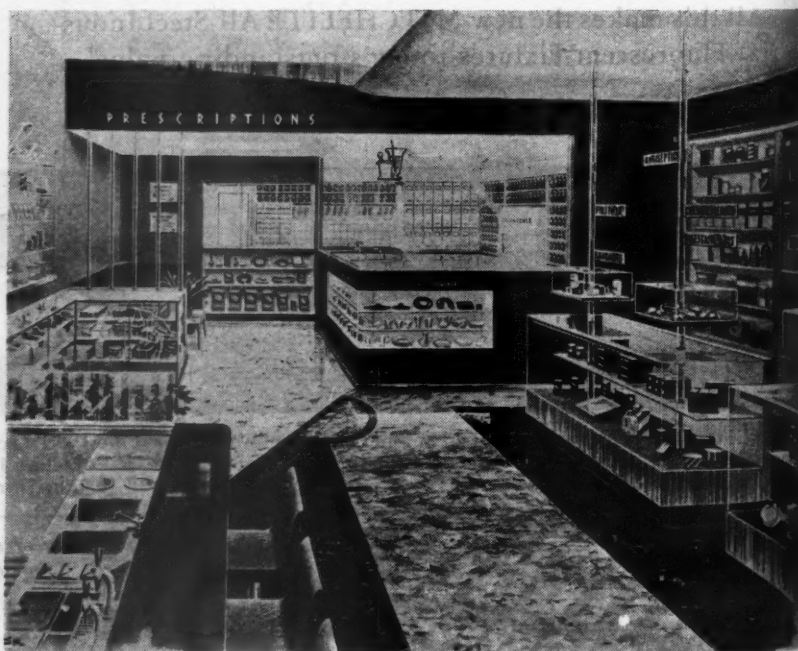
High quality illumination is a proven aid to retail merchandising. Smart display of goods, high-lighted by spot and local light permits the merchandise to sell itself. Correct illumination is one of the most important tools in marketing and the vast majority of retailers will want modern lighting to play an important role in their planned modernizations when material again becomes available for that purpose.

The Armstrong Cork Company has been currently offering model designs for various types of retail outlets. One of their recent proposals was that of a drug store, the design of which has been based upon a research program conducted by the National Association of Retail Druggists.

The indirect lighting treatment achieves a smart, modern effect throughout the entire store area, and the general illumination is supplemented by display lighting which shows off merchandise to the greatest advantage.

The lamps producing the indirect general illumination are concealed above a dropped, false half-ceiling, and their rays are pleasingly reflected by the true ceiling. Shadows and glare are eliminated and the light is soft and diffused. It is pointed out that indirect lighting—efficiently planned and installed—is an important factor in reducing lighting costs.

Tubular lighting over shelves and in display cases, and spotlights for special displays, are recommended as a most effective way to feature merchandise.



DROPPED FALSE CEILING conceals light sources while true ceiling reflects a high quality and quantity of soft, well-diffused light.

QUICK, EASY INSTALLATION! LOW MAINTENANCE COST!



JOLECO SPECIFIC LIGHTING IS FLUORESCENT EQUIPMENT AT ITS BEST

Wherever utility, maintenance and appearance are of equal importance, Joleco Fluorescents are now providing steady, trouble-free, soft, non-glare light specifically engineered for greater productive efficiency in offices, factories and stores from coast to coast.

Incorporating, among many exclusive features, these advancements—one-piece top and bottom plate construction for installation speed—easily removable reflector plates for simplicity of maintenance—scientific ventilation principle for maximum heat dissipation—Joleco offers the best in good lighting and improved design at the lowest total cost.

Devoted only to war production for the past three years, Joleco engineers have contributed to and learned much about the science of light. Again Joleco is ready to offer architects, contractors, engineers and other interested executives its counsel and aid in solving their problems of low-cost, low-maintenance, "production-plus" illumination.

Write freely and without obligation.

JOLECO

CORPORATION
Designers and Manufacturers

FLUORESCENT LIGHTING FIXTURES



The ultra-modern Shell Building in St. Louis, only one of many in which Joleco Fluorescents are standard equipment throughout.

QUESTIONS ON THE CODE

POWER CABLE

Q. "Can 60 cycle power cable be run in the same conduit with a 25 cycle power cable?"—G.L.R.

A. Yes. The National Electrical Code up to and including the 1937 Edition, prohibited, in Section 3013, the use of conductors of different systems in the same enclosure.

This, however, was changed in the 1940 Edition of the Code. We now find in the second sentence of Section 3013 that "conductors of light and power systems of 600 volts or less, may occupy the same enclosure only if all conductors are insulated for the maximum voltage of any conductor within the enclosure."

The prohibition against common occupancy of enclosures still is restrained for putting signal or radio conductors in with light and power wires except for the few cases stated in the first sentence of section 3014 and also the installation of wires of over 600 volts in the same enclosure with wire of 600 volts or less is still prohibited by the last sentence of 3013.—F.N.M.S.

PORTABLE CORDS IN GARAGES

Q. "We recently have become involved in a dispute regarding type of connection for portable cords in garages. May the ordinary two prong connector be used on portable lamp or appliance cords in garages when it is attached to female connectors permanently attached to the building structure at a height of at least four feet above the floor?"—F.B.

A. No, ordinary unpolarized two prong male connectors cannot be used on portable cords in garages. Section 5107 of the N. E. Code reads as follows: "Cords used for the connection of portable appliances shall carry the male end of a polarity type pin-plug connector, or equivalent, the female end being of such design or so hung that the connector will break

apart readily at any position of the cable." This requirement is too seldom enforced in spite of the fact that compliance with it would lessen the hazard to life and property.—G.R.

WIRING SHOWCASES

Q. "I recently issued a permit for the wiring of several showcases and upon inspecting them found that they were wired with a thin wall tubing having an inside diameter of approximately $\frac{1}{8}$ inch. Inasmuch as the Code states that $\frac{1}{2}$ inch thin wall tubing shall be the minimum size used for ordinary work, is permission granted to use the smaller raceways on showcases?"—A. P.

A. The showcases should have been rewired with $\frac{1}{2}$ inch electrical metallic tubing as Section 3486 of the N. E. Code reads as follows: "No tubing smaller than $\frac{1}{2}$ inch, electrical trade size, shall be used except as provided for underplaster extensions in Article 358 and for enclosing the leads of fractional hp. motors as permitted in Section 4439."—G.R.

BOXES AT SWITCH POINTS

Q. "Are boxes (metal or otherwise) required at switch points on an open wiring job?"—R.W.E.

A. No, boxes are not required on open wiring on insulators. Our rule on this is Section 3014 which is under "Provisions Applying to All Wiring Installations" (See heading preceding Section 3001). Section 3014 states the various wiring methods with which boxes are required at switch, and other points inasmuch as open wiring is not mentioned among those listed, it is exempted from the general rule.

Of course it would be necessary to use devices which would maintain the proper separation of wires from each other and from surfaces wired over on this method of wiring. There are devices approved for this use.—F.N.M.S.

PLUG-IN STRIP INSTALLED IN PLASTER

Q. "Can the plug-in strip with attachment receptacle be installed in plaster finish so that the face containing the receptacles will be flush with the plaster finish?"—M.S.

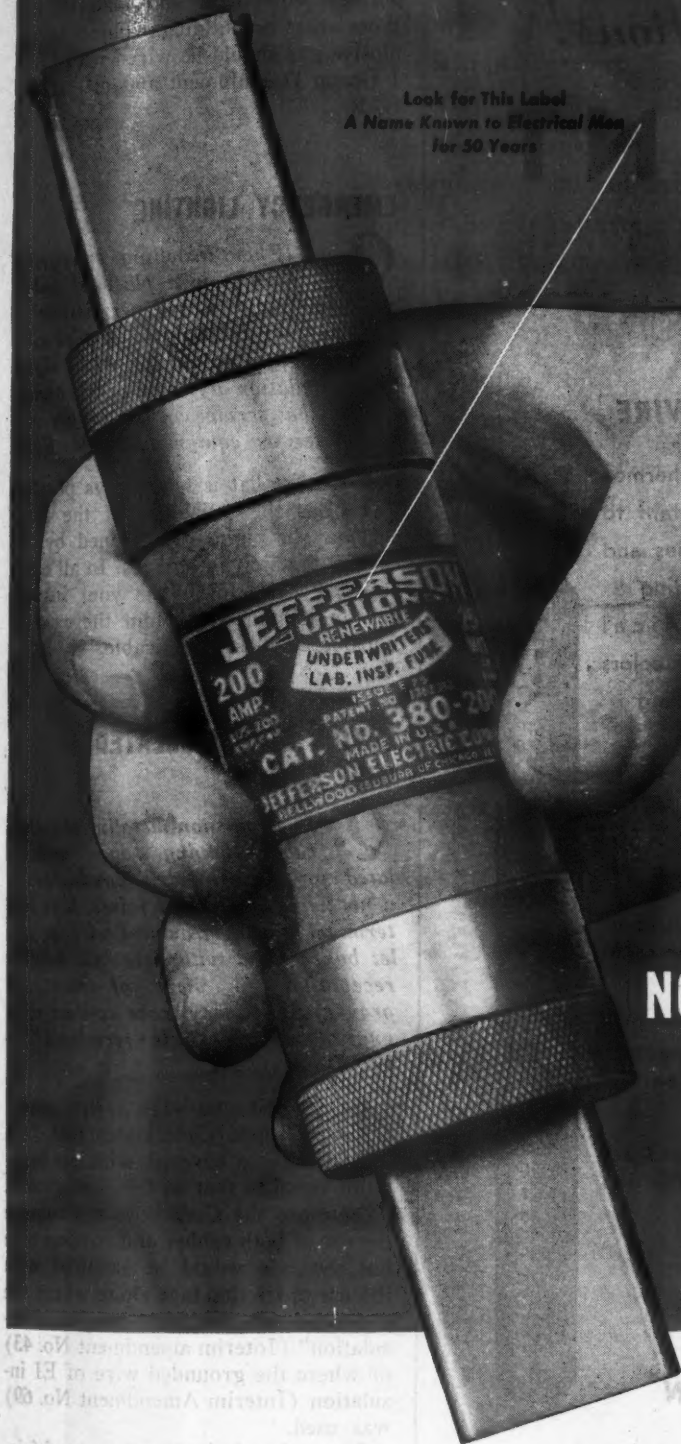
A. Yes, Section 2522 of the Code permits this use of a type of metal surface raceway wherein it states that metal surface raceway shall not be used concealed "except that the back and sides of multi-outlet assembly may be surrounded by the building finish." This would permit the use of it in the plaster with only the face exposed or on top of the baseboard with the baseboard trim mounted just above it.—F.N.M.S.

SEWAGE DISPOSAL PLANT

Q. "What type of electrical installation should we specify for the proposed sewage disposal plant now being planned for our town?"—L. A.

A. All too often sewage disposal plants are found wired with ordinary equipment and materials which are bound to cause trouble within a comparatively short time because of either the corrosive or explosive atmospheres usually found in most of the buildings of such plants. Digester and sludge buildings are likely to contain both corrosive and occasionally explosive atmospheres. The chemical change taking place gives off methane gas which under proper conditions may form explosive mixtures. Screen and grit buildings may contain corrosive atmosphere only unless the municipality in question does not have proper control of the disposal of waste flammable liquids or in those installations where sewage is delayed during transit long enough to permit decomposition. If possible the majority of control and all of the service equipment should be located in a separate building or cut off room.

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Jefferson-Union Renewal Links are of the multi-notched type, providing reliable protection under normal and severe operating conditions. The notches in the center of the link localize the heat generated during operation, producing lower temperatures at the fuse terminals. When sub-

jected to heavy overloads or short circuits, the multiple restricted portions of the link are fused and serve to break the arc in several places, thus a minimum amount of metal is volatilized and minimum internal pressure is generated within the fuse. The design of this link insures maximum performance and long-life for the fuse.

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is approved by Underwriters Laboratories in sizes from #14 through #4/0 A W G under section 3035 of the 1940 N. E. Code for use in raceway systems, such as:

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Buildings containing corrosive atmospheres only should be wired with vaportight equipment and material and those areas or buildings subject to explosive gas should be wired with Class 1 Group D equipment and material.—G. R.

EMERGENCY LIGHTING

Q. "When installing emergency lighting in a place of public assembly, is it always permissible to take that supply from the service conductors supplying the principal lighting installation by making a connection to that service on the supply side of the service equipment?"—M. S.

A. No, that is not always possible as the reliability of the service may be rightly questioned by the local inspection authorities. In all cases it is advisable to contact your inspector and obtain from him the method considered most practicable.—G. R.

TAPING OF UNINSULATED WIRE SPLICES

Q. In using non-metallic sheathed cable having one uninsulated or EI grounded conductor is it not necessary to tape joints, taps and terminal ends of grounded wire in outlet boxes fitted with porcelain keyless receptacles in view of fact the grounded wire may make contact with ungrounded receptacle terminals?"—U.S.D.

A. In Section 4136 the National Electric Code states that "the joints shall be covered with an insulation equal to that on the conductors". Therefore the Code does not require the use of both rubber and friction tape but the rule would be satisfied with the use of friction tape alone where the grounded wire "without individual insulation" (Interim amendment No. 43) or where the grounded wire of EI insulation (Interim Amendment No. 69) was used.

The writer feels that the use of friction tape alone is very poor practice and strongly recommends the use of both rubber and friction tape although evidently the Code would require only the friction tape. The point raised by the inquirer over the possible contact of the splice with the ungrounded terminal of the receptacle is sufficient reason for using the rubber tape also.

Our inquirer also mentioned EI insulation. Code recognition of EI insulation has been rescinded by the deletion of Interim Amendment No. 69, but of course there may still be some

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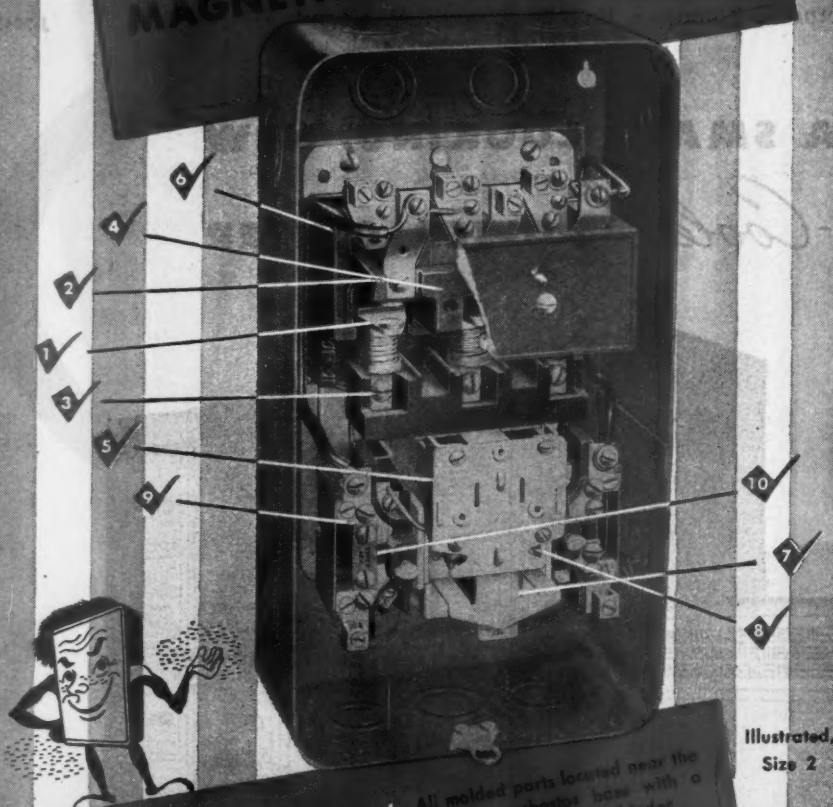
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5. Ball bearings and movable yoke are retained under a screwed-on top plate. All parts are replaceable.
6. All molded parts located near the contacts are asbestos base with a non-carbonizing inorganic binder.
7. Straight line vertical ball bearing action.
8. The coils are readily changeable, even in the cabinet. Pull out the retainer spring, loosen yoke and take out the magnet, and the coil is free.
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cable with this type of insulation on the grounded conductor in stock.

Happily, we will not be confronted with the above problem in our regular run of residences and other buildings. —F.N.M.S.

CARRYING CAPACITY

Q. "We recently installed two circuits in a single conduit run supplying two 10 hp. three phase 230 volt motors. These circuits consisted of No. 8 type R conductors and yet the inspector claims the conductors are not of sufficient size to comply with the Code. Does not the Code as amended state that the carrying capacity of a No. 8 type R wire is 35 amperes?"—S. F.

A. If there were only three conductors in a conduit run supplying a single 10 hp. 230 volt motor, No. 8 type R wires would suffice. However, in this case there are six No. 8 conductors within a single conduit making it necessary to reduce the allowable carrying capacity of each conductor to 80 percent of that shown in the amended table. Therefore the inspector was correct in requiring larger conductors.

This requirement is found under Item 5 on page 303 of the National Electrical Code and reads as follows: "Table 1 gives the allowable current-carrying capacity for not more than three conductors in a raceway or cable. If the number of conductors in a raceway or cable is from 4 to 6, the allowable current-carrying capacity of each conductor shall be reduced to 80 percent of the values in Table 1. If the number of conductors in a raceway or cable is from 7 to 9, the allowable current-carrying capacity of each conductor shall be reduced to 70 percent of the values in Table 1."—G. R.

OFFICIAL INTERPRETATIONS

by the

Electrical Committee of the N.E.P.A.

Interpretation No. 261

STATEMENT . . . A small capacity space heater using solid fuel is equipped with a fractional horsepower fan or blower supplied by a 2-conductor cord.

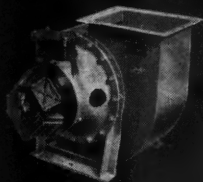
QUESTION . . . What provisions of the National Electrical Code require grounding of this assembly?

FINDING . . . Grounding is not required if the supply circuit is not over 150 volts to ground; however, grounding is recommended in the second fine print note following paragraph (c) of section 2545.

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special features such as the patented Self-Cooled Motor on Propeller Fans. Finally, you get the full protection of the “ONE-NAME-PLATE” Guarantee covering each complete unit, *including the motor.* For finest quality air handling equipment for home, business or industry, call nearby Branch Office (consult classified directory) or write us today.

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ELECTRONICS

Installation, Maintenance and Servicing of Electronic Motor Control—II

ELECTRONIC motor control is similar to other types of electronic control in that practically all of the troubles encountered are relatively simple, and easily repaired with very little knowledge of the circuits and without elaborate instruments and equipment. In order to be prepared to meet any trouble that might arise, however, one must know the circuits sufficiently well to be able to isolate the trouble with the help of the necessary instruments.

Instruments

The following instruments should be considered the minimum necessary to service electronic motor control:

1. A vacuum-tube voltmeter or a high resistance volt-ohmmeter.
2. Several sizes of d-c ammeters.

Vacuum Tube Voltmeter

The commercial vacuum-tube voltmeter, because of its inherent flexibility, will help in finding both the simple and more complex troubles which may arise. It may be used instead of a bell set to check circuits for correctness or for "shorts" or "opens." It will measure the resistance of transformer or reactor windings as well as the resistance of any panel resistor or external resistor. The a-c voltage scales will measure a-c line voltage, anode transformer secondary voltage, a-c control voltage, and the various tube filament voltages. Because an extremely small amount of current flows through these instruments, they are ideal for measuring the d-c voltage throughout the low power, high resistance electronic control circuits which might be disturbed by low resistance type d-c meters. Vacuum-tube voltmeters can be used

B. J. Dalton
Industrial Engineering Division
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as well as conventional meters to measure motor power circuit voltages.

For most electronic equipments, including those mentioned here, a voltmeter with a resistance of 20,000 ohms per volt will be just as suitable as a vacuum-tube voltmeter. Commercial forms of these instruments include a-c and d-c voltage scales as well as resistance scales.

The instruction books accompanying these instruments give detailed operating procedure.

D-C Ammeter

The d-c ammeters should be suitable for measuring the current in both the armature and field circuits of the motor. The instruments should also be

capable of reading any overload placed on the motor. An approximate figure of four amperes per horsepower at 230 volts d-c will be satisfactory for determining armature ammeter sizes. Field currents will generally vary from about one-half ampere for a 1-hp motor to about three amperes at 20 hp.

Cathode-Ray Oscilloscope

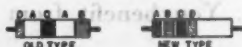
While the cathode-ray oscilloscope is not essential for servicing electronic motor control, it will remove much of the fear of electronic equipment because it lets one see what is actually going on in the various circuits. Because it transforms what appears to be a static device into a very real piece of moving machinery, it is invaluable.

A slight modification is usually necessary to make commercial oscilloscopes suitable for seeing the d-c and the combination of d-c and a-c voltages which are present in motor control circuits. To see these voltages in their true relations, it is necessary to apply them directly to the two vertical deflecting plates of the cathode-ray tube.

General Suggestions for Trouble Shooting

Because no description of trouble-shooting could ever list completely all possible causes of trouble, it is important that a trouble-shooter become somewhat familiar with the general causes of trouble, but more specifically with the methods of finding them. This article will use an actual control circuit as an example, but its usefulness is not limited to this particular circuit. Rather, it will attempt to show the correct approach, as almost any trouble becomes easy to find once the approach is recognized.

LARGE RESISTORS USED ON CONTROL PANELS USUALLY HAVE THE RATINGS PRINTED OR STAMPED ON THEM. SMALL RESISTORS OF TWO WATT SIZE AND BELOW ARE MARKED BY THE FOLLOWING COLOR CODE. RESISTOR VALUES ARE IN OHMS.



A - COLOR FOR 1ST SIGNIFICANT FIGURE
B - COLOR FOR 2ND SIGNIFICANT FIGURE
C - COLOR FOR 10 OF DIGITS OR MULTIPLIER
D - GOLD OR SILVER INDICATES TOLERANCE, WHEN APPLIED.

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE
BLACK	0	1
BROWN	1	10
RED	2	100
ORANGE	3	1,000
YELLOW	4	10,000
GREEN	5	100,000
BLUE	6	1,000,000
VIOLET	7	10,000,000
GRAY	8	100,000,000
WHITE	9	1,000,000,000
GOLD	± 5% TOLERANCE	
SILVER	± 10% TOLERANCE	
NO COLOR	± 20% TOLERANCE	

EXAMPLES

RESISTORS
(1) 10 OHMS BROWN (1) RED (2) GREEN (100,000) GOLD (± 5%)
40,000 OHMS BLUE (3) BLACK (4) ORANGE (1000) SILVER (± 10%)
510 OHMS GREEN (5) BROWN (1) BROWN (± 10) ---
2.5 OHMS ORANGE (3) GREEN (5) GOLD (± 0.1) GOLD (± 5%)

FIG. 1. R.M.A. standard color code for small resistors.



How RCA Electron Tubes Speed Wood Bonding 700%

Electronic Heat Helped Tolerton Lumber Co. Multiply Production of Wooden Aircraft Members.

A CRITICAL shortage of Grade A spruce of adequate size threatened to limit manufacture of wood aircraft.

As solid planks from which wing spars were cut became harder and harder to find, manufacturers resorted to ingenious bonding together of easily available, random pieces, but production time and costs increased sharply.

To lick this new problem, the Tolerton Lumber Co., Alliance, Ohio, applied electronic heating.

They developed methods by which electronic heating "set" glued joints in 2 minutes . . . instead of hours as formerly required by cold-setting. They found that it took only 20 minutes for electronic heat to bond several planks into a laminated 6" x 6" x 16½' beam . . . as against 4 hours in a hot-plate press!

Electronic heat at Tolerton is provided by an RCA 16-kw electronic generator, in which power from the commercial supply is converted from a frequency of 60 cycles to 10 million cycles. Two RCA Type 892-R

oscillator tubes and six RCA Type 872-A/872 rectifier tubes are used.

Results:

1. The Tolerton plant output jumped from 25 to 200 spars per day, because of shortened press time.
2. The setting of the glue is complete, because electronic heating produces uniform temperature throughout the glue line.
3. Lumber costs were cut about 40% by use of odd pieces.
4. In tests, the joints proved stronger than the wood itself 100% of the time — well above the government specifications.

Other Applications By Tolerton: Mr. R. I. Tolerton, Vice President of the Tolerton Co., reports that "we are also using this electronic method of gluing in the manufacture of lithograph backing blocks, steel-

mill hammer boards, and 6-inch square maple blocks, which are later turned to make wheel-bearings for bombers. In each case the result has been important savings in time and expense, and more accurately made products because of the better glue adhesion obtained by electronic heat."

For Further Information on the Tolerton operation, send for free 8-page article, "Electronic Heating Sets Glue in Laminated Aircraft Spars." For examples of electronics at work in our own factories, send for the free 32-page booklet, "Electronics in Action at RCA." Address all inquiries to RCA, Commercial Engineering Section, Dept. 62-508, Harrison, N. J. If you have any problem involving the use of electron tubes, RCA tube-application engineers will be glad to help you or to put you in touch with a manufacturer who can.

Remember, the Magic Brain of all electronic equipment is a tube . . . and the fountain-head of modern Tube development is RCA.



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Methods

There are two general methods of locating a faulty device. The first is a mechanical approach in which all devices suspected are either checked or replaced. The second is an analytical approach in which functions and the circuits that provide these functions are isolated and checked for trouble. Experience will show that the ideal method is a combination of the two.

The trouble shooting chart in Part I of this article lists a number of troubles and their possible causes. Practically all of these may be found either by testing circuit components or by measuring voltages. A vacuum-tube voltmeter can be used to measure the resistance of all transformer and reactor windings, and all contactor and relay coils; to test capacitors for open and short circuits; to measure resistors; or to find short and open circuits in the panel wiring.

It is helpful to know all circuit constants and voltages in a specific equipment, but in the absence of more definite information the voltages and resistances included in the following paragraphs may be used as rough guides in testing circuits and components. A careful study of the following paragraphs will be of considerable help in finding trouble.

Anode Transformer and Control Voltages

Anode transformer secondary voltages from center tap to the anode connection of one of the tubes should be in the neighborhood of 200 to 400 volts, depending on the motor voltage and the number of power tubes used. There will be approximately 300 volts from the center tap to the anode on a two-tube rectifier with a 230-volt motor. A four-tube rectifier on a 230-volt motor will have approximately 200 volts from

center tap to anode. The voltage from center tap to the anodes of all tubes in a particular rectifier should be approximately equal.

A-c control voltages are usually 110 volts but may be any standard voltage. The a-c control circuit voltage often stamped on contactor coils will help determine correct control voltage.

The a-c scales of a vacuum tube voltmeter will readily indicate both the anode and control voltages.

Tube Voltages

Tube type numbers often give some clue as to their operating voltage.

For example:—The d-c voltage across a glow tube may be indicated by its type number. A VR150-30 should have approximately 150 volts across it. A VR75-30 should have approximately 75 volts across it. These voltages can be read on the d-c scales of a vacuum tube voltmeter.

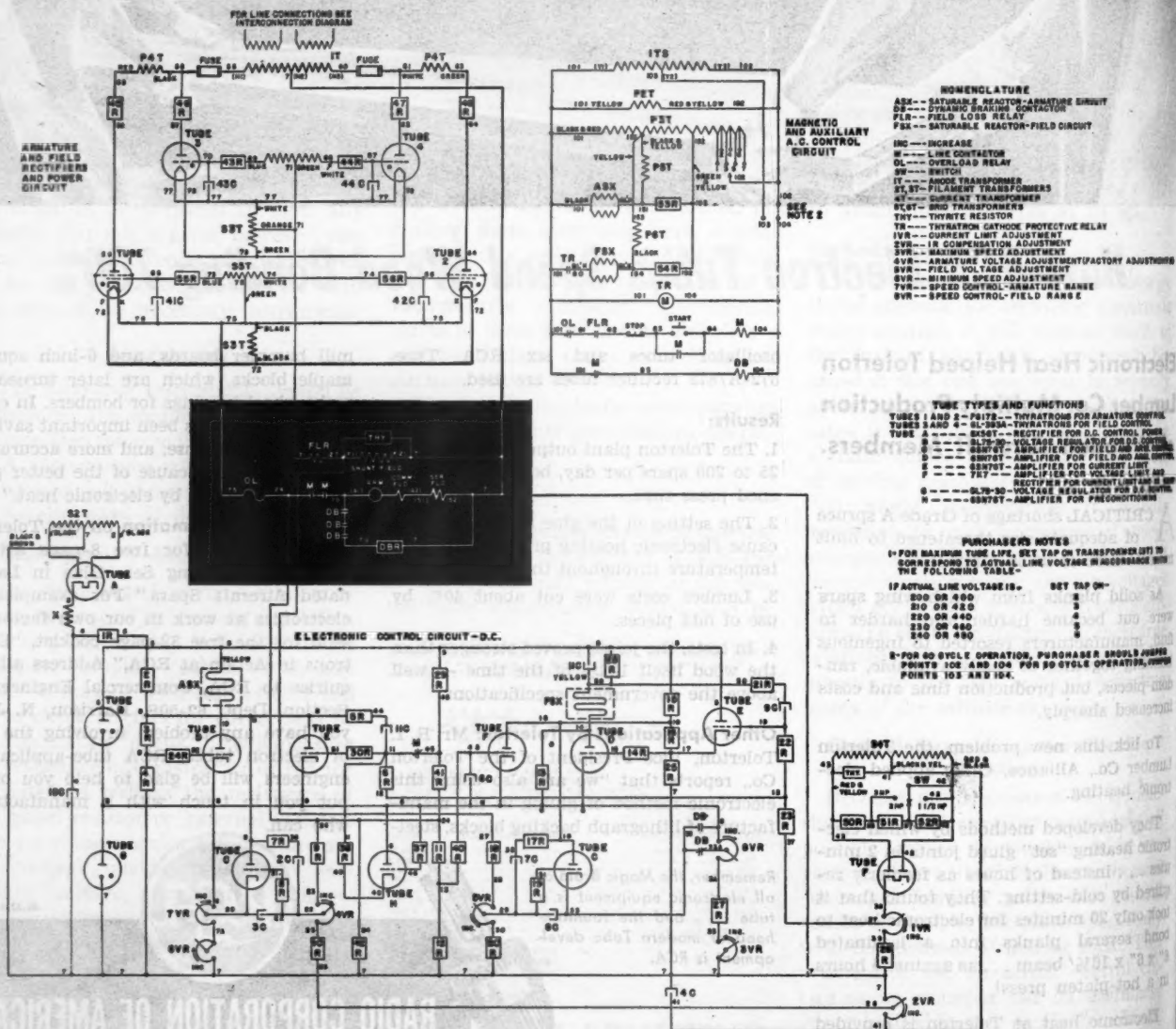
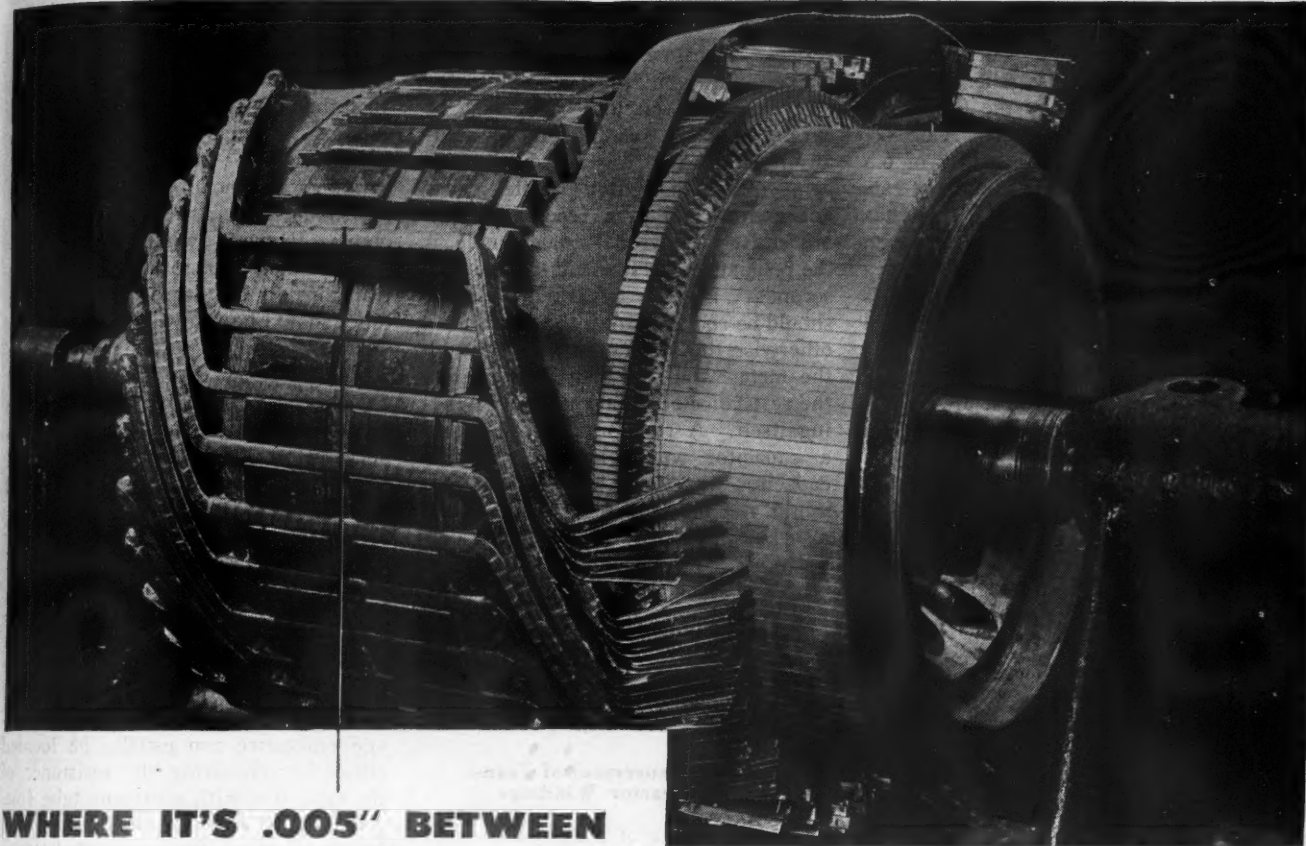


FIG. 2. Elementary wiring diagram which shows circuit elements in a simplified rearrangement for easy reading. Note that the d-c control circuits are arranged so that points of higher positive potential are positioned higher on the drawing. Positions are approximately relative to their operating potential. Note also that only three wires emerge from the d-c control to the motor; and three wires from the field and armature power section to the motor.



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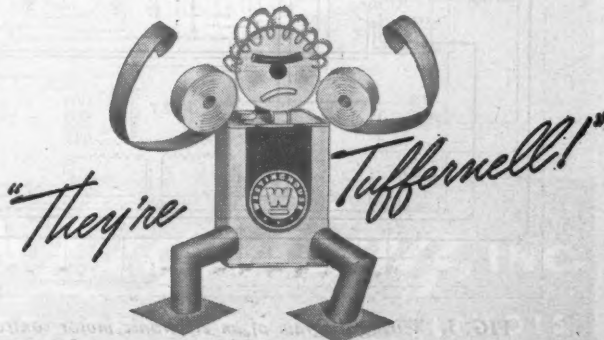
Some valuable portions of this "insulation know-how" are included in the new Insulation Sample Book which simplifies selection of Micas, tapes, fabrics and papers *with actual samples*. It helps identify different grades, gives dimensions, ratings, and helpful application data. Copies are available through your nearest Westinghouse distributor. Ask for B-3322. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

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INSULATING MATERIALS



The filament voltage of receiving type vacuum tubes is generally indicated approximately by the first number in the type designation. A 6SN7-GT tube has a filament rating of 6.3 volts. A 25Z6 tube has a filament rating of 25 volts. A 117P7 tube has a filament rating of 117 volts. Although various tubes have filament voltages which cover a wide range, the tubes used in this type of equipment will usually be rated 6.3 volts.

Thyratron and phanotron power tube filament ratings are almost always below six volts. Typical ratings are 1.25 volts, 2.5 volts, and 5.0 volts.

The low voltage a-c scales on a vacuum-tube voltmeter can be used to measure filament voltage. Although the readings may not be extremely accurate, they may be used to determine whether the filament voltage is of the proper magnitude.

Proper Method of Measuring Resistances

Most vacuum-tube voltmeters can be used to measure resistance. Full scale resistance readings usually range from 100 ohms or lower to 10 megohms or higher.

When measuring the resistance of a

resistor, transformer winding, or capacitor, or even when checking for open or short circuits, one must be careful that the readings taken actually represent the resistance of the part being measured. Often parallel resistance paths will give readings which are entirely in error. For example, if the resistance of a filament transformer secondary is being measured, all tubes should be removed from their sockets—otherwise the resistance value read on the meter would be much lower than the resistance of the transformer winding itself. A resistor in parallel with a capacitor would indicate that the capacitor was faulty, when actually it might not be. Other examples could also be shown.

If there is any doubt as to whether other resistance circuits are in parallel with a particular unit, all leads should be removed from one of the two terminals of the particular unit being measured. This will assure the proper resistance measurement.

Resistance Measurement of Transformer and Reactor Windings

The resistance of transformer windings is dependent on the size of the transformer and the voltage ratings of

a particular winding. Large transformers have lower resistance windings than small transformers. High voltage windings have higher resistance than low voltage windings. All windings of anode power transformers should have a resistance below 10 ohms. Primary windings of thyatron filament transformers or filament transformers for the several control tubes should be below 100 ohms. Filament transformer secondary windings should be below 10 ohms. Small grid transformers, reactor, and saturable reactor windings should have resistances below 10,000 ohms. Other small control transformer resistances should be under 1,000 ohms.

Capacitor Measurement

Capacitors may be measured accurately with a capacitance bridge. For service work, however, where accuracy is not too important, shorted capacitors or capacitors with low leakage resistance can usually be located either by measuring the resistance of the capacitor with a vacuum tube voltmeter or by a direct substitution of a known good one for a suspected one.

Capacitors of .05 microfarad and smaller should have a resistance not lower than 10 megohms. Capacitors between 0.1 mfd. and 1.0 mfd. should have a resistance not lower than 5 megohms. Larger capacitors are usually used in circuits where a low leakage resistance may not cause faulty operation, but even they should have resistances of at least 1 megohm. If there is any question about a particular capacitor, a good one should be measured for comparison.

Although a resistance measurement will not locate directly open-circuited capacitors, the resistance measuring portion of a vacuum-tube voltmeter will indicate whether or not most capacitors are open. To make this test the instrument should be connected to a high reading resistance scale. It is important that no other circuits parallel the capacitor. If the meter swings up scale and then back at the instant the leads are touched to both capacitor terminals, the capacitor is O.K. The amount of swing will be determined by the size of the capacitor and the resistance scale being used. Large capacitors will give a much greater swing than small ones. Very small capacitors (.001mfd. and smaller) cannot be tested in this manner because the meter swing will be too small to see. If this test is repeated the capacitor terminals should be shorted between tests.

Electrolytic capacitors cannot be easily tested by resistance measurement because they may have a low leakage

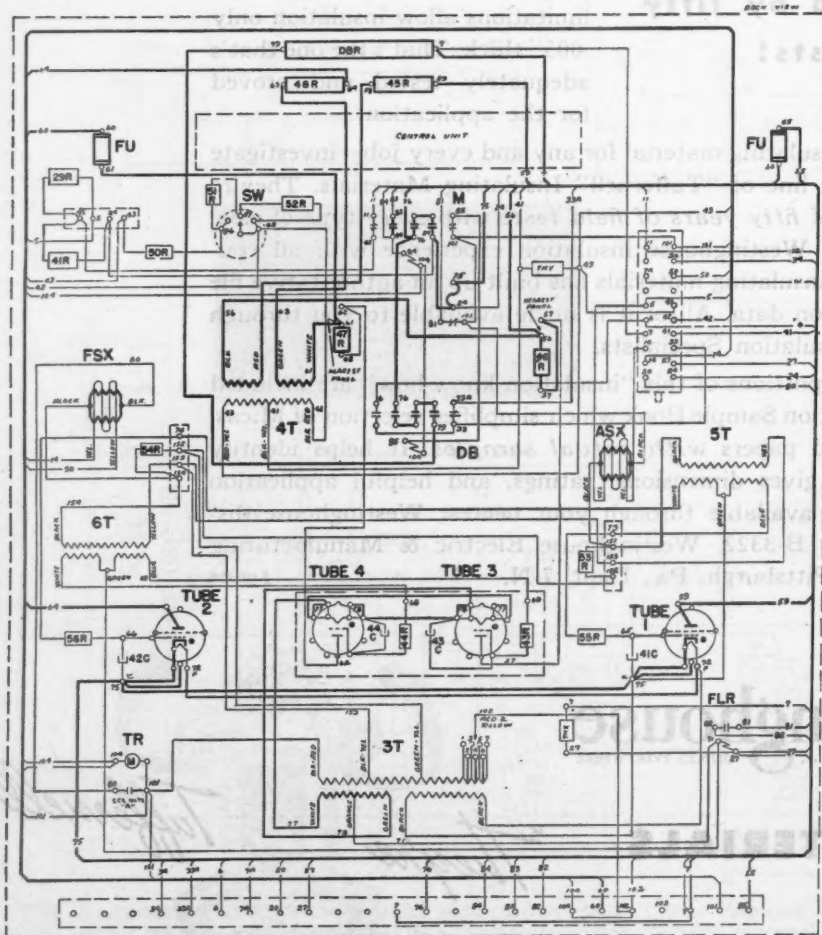


FIG. 3. Wiring diagram of an electronic motor control panel. Circuit elements are in their approximate position and can be compared with photo. (Fig. 4).

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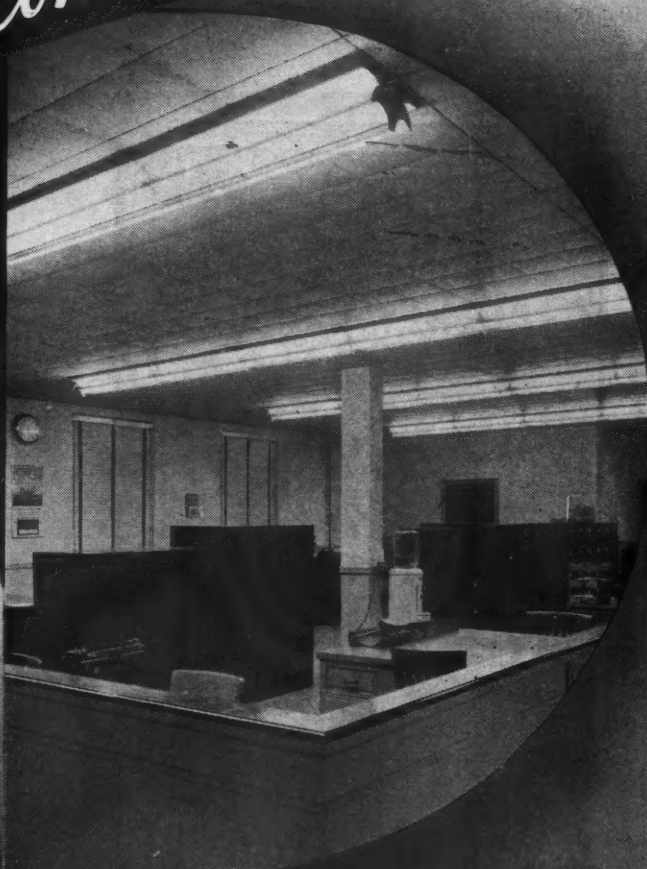


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When it comes to four-lamp luminaires the Curtis StarLux is the "ne-plus-ultra" . . . for quality of design and manufacture. This unit delivers efficient lighting with low surface brightness and is at the same time one of the most beautiful luminaires on the market. StarLux is first choice for those ultra commercial jobs which demand quality and efficiency. Easy to install, maintain and sell.

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By long odds this is the outstanding two-lamp unit on the market. It carries a terrific double sales punch . . . first it's a Curtis product . . . next its cleverly designed shielding conceals the lamps from normal angles of view and the highly efficient Fluracite reflectors deliver a high light output. Where ceiling units are indicated Skylux is really the modern contractor's number one choice.



CURTIS *Lighting*, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

resistance, particularly if power has been off them for some time. The best test of these capacitors in the absence of a capacitance meter is to make a direct substitution of a good one.

Resistors

The resistance value of small carbon type resistors is usually indicated by the colored bands around the resistors. Some resistors have the body of one color, one end of another color, and a dot at the center, or a stripe around the center of another color. Other resistors have three stripes near one end. In the first type the sequence of colors is—*body, end, dot or stripes*. In the second type the sequence of colors is from the end to the center. In either case the colors have the same meaning. Fig. 1 shows the various colors and the associated numbers.

The three colors can be combined to give the resistance value in the following way—The first color indicates the first number. The second color indicates the second number. The third color tells how many zeros to place after the first two numbers. The colors of brown (1), black (0), and orange (3), for example, indicate a resistor of 10,000 ohms.

Another color is sometimes added to tell how near the resistance value should be to that actually indicated by the other colors. A gold band indicates that it should be within 5 per cent, a silver band within 10 percent, and no band indicates 20 percent tolerance.

Resistors that are not color coded usually have the value stamped somewhere on the unit.

Interpretation of Diagrams

Any complete equipment diagram consists of two basic sub-divisions—an elementary diagram and a wiring diagram.

Elementary or Schematic

An elementary or schematic diagram is made primarily to show in the simplest possible manner the electrical circuit for the entire equipment. Therefore no thought is given to the actual physical location of the various parts. This diagram is a great help in analyzing the various circuits to see how they operate and to locate possible causes of failure.

Fig. 2 shows a complete elementary diagram of a standard 2 hp. single-phase, non-reversing electronic motor

control which provides control for both the armature and the shunt field of a d-c motor. In this stage it looks quite complicated. Part of this complexity is due to the number of different circuits involved. These will be broken down into individual simple circuits and discussed later. Aside from this apparent complexity, however, certain customs and practices result in unnecessary confusion unless one is able to interpret them.

Nomenclature

Usually there is not sufficient room on the diagram to completely describe all the various devices. On the drawing, therefore, each unit is given an abbreviated title which is explained in the nomenclature list. For example, ASX in Fig. 2 is listed in the nomenclature as: Saturable reactor—armature circuit. Resistors and capacitors are numbered arbitrarily and are not generally given any other title. On the other hand, the adjustable resistors and potentiometers are usually given some title to help in identifying them.

Tube Designations

Sometimes tube type numbers are located beside the tube symbols. In

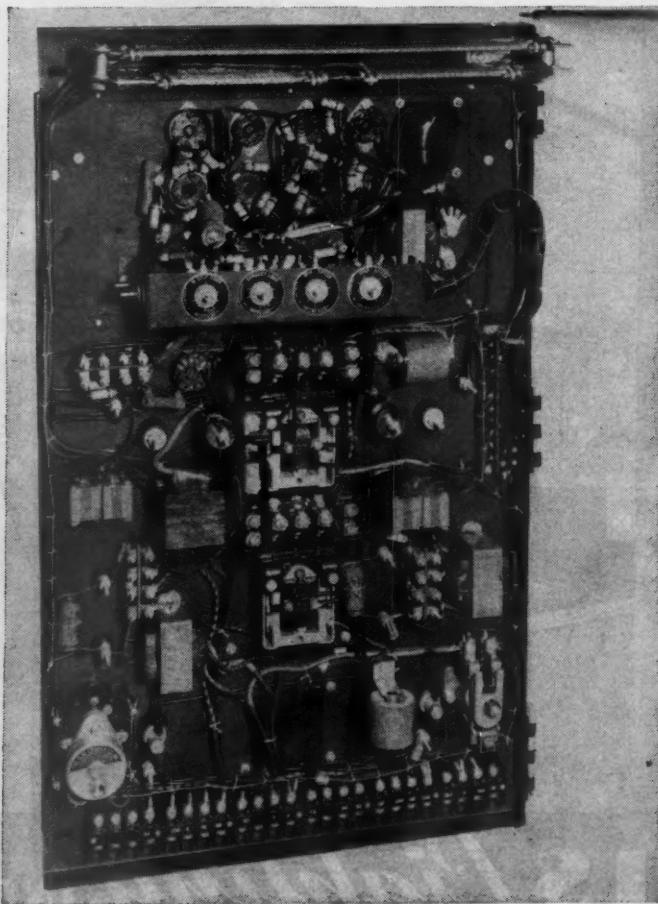


FIG. 4. Panel wiring of Thy-mo-trol armature and field control, non-reversing, 2 hp., 230 volt d-c motor. Compare the component parts with those in Fig. 3.

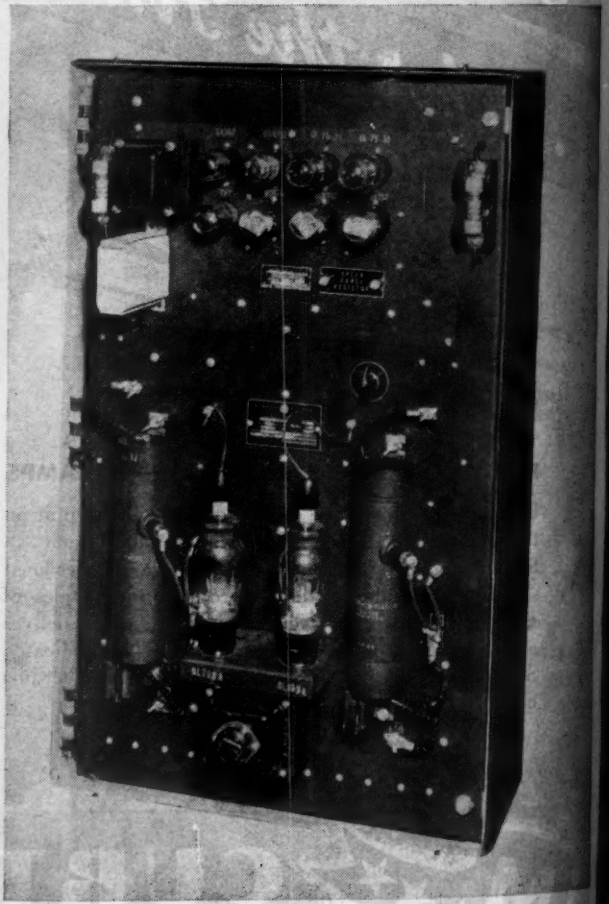


FIG. 5. Electronic motor control panel showing armature and field thyatron tubes, constant voltage glow-tubes, rectifiers, and other control tubes with relay, and filament and anode transformers.

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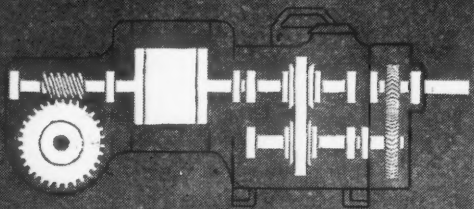
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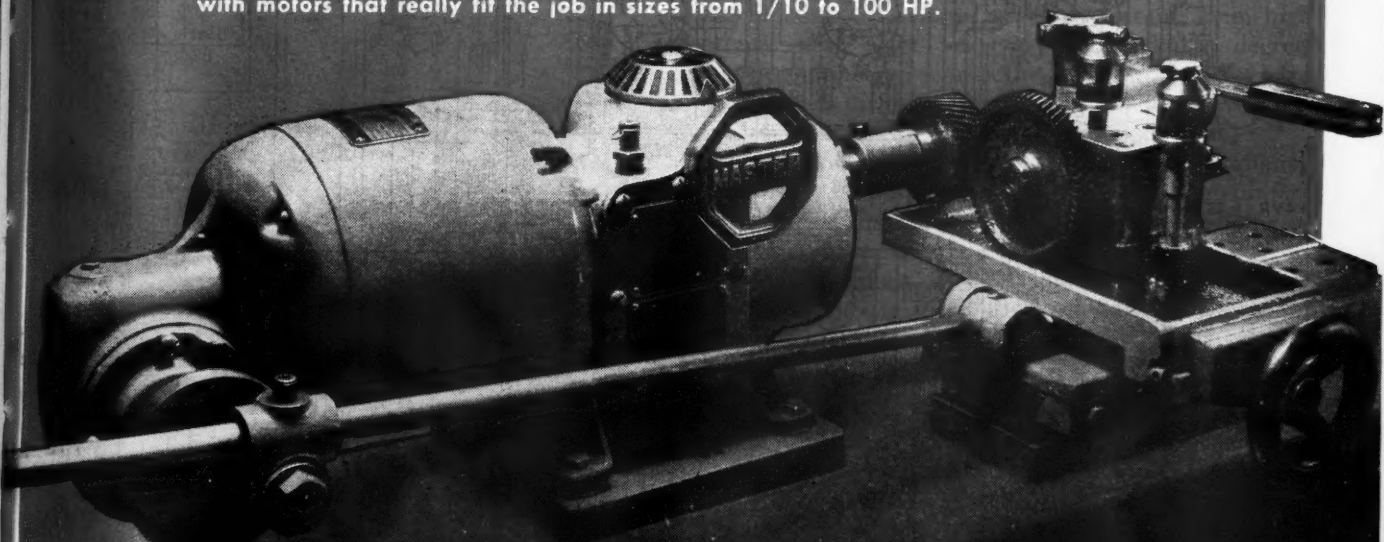
DOUBLE FEATURE

Ingenuous fellow, the designer of this gear lapping machine. Fully alert to the wide diversity of the Master line, he has been able to select units which combine to give him exactly the "double feature" action he needs.

This power drive incorporates a mechanical variable speed unit and a stage of gear reduction on the right hand end to provide variable speeds, in exactly the right range, for the spindle drive. On the other end is a right angle worm gear drive that provides oscillating motion for the lapping table. All of these . . . the motor, the variable speed drive, the two gear reductions . . . all are standard Master units, that easily combine into one compact, integral, power package. Saves ordering and mounting time . . . saves space . . . saves money.

Probably you will not need exactly the same combination of motor features illustrated below, but the Master line includes motors for every current specification, every type of enclosure, and every type of mounting arrangement . . . in fact, is the most flexible, the most versatile line of motor drives in the world.

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many cases, however, the tubes are numbered or lettered or, perhaps, the power tubes are numbered and the control tubes lettered.

If you examine carefully the control tube lettering in Fig. 2, you will notice that there are two tubes labelled—"Tube C", also two labelled "Tube D", "Tube E" and "Tube F", respectively. Tubes are labelled in this manner to show that both units, which bear the same letter, are actually enclosed in a single glass envelope. The two individual sets of tube elements however may be and actually are located in entirely separate parts of the complete circuit. This is done for the reason that from a circuit operation standpoint and for clarity in reading the diagram, the procedure is simplified by separating the two tube sections as shown.

Transformers

At first glance, transformer and reactor terminology and connections may also seem queer, but here, as in the case of tubes, there is a definite system which is simple when it is understood.

One transformer may have a number of different windings, each of which is used in a different part of the circuit. In a case such as this, it is much simpler, from a circuit standpoint, to show the windings in the circuits where they are used than it would be to have all

the leads running to a common location. In locating windings at various points in this manner, however, it is important to be able to recognize which windings are on the same transformer. Therefore, an identification system must be used.

For an example, let us take transformer 3T, listed in the nomenclature as a filament transformer. The primary of this transformer, connected between lines 101 and 102, is labelled P3T. The secondaries are both labelled S3T, and are used to heat the filaments of the armature and field power tubes, respectively. S3T between line 72 and 75 supply the armature-tube filaments, while S3T between lines 77 and 78 supply the field-tube filaments.

The saturable reactors have two windings—an a-c winding and a d-c winding. The d-c windings are located in the d-c control circuit, while the a-c windings are located in the a-c control circuits. Both windings of any reactor have the same identification (ASX or FSX), indicating that they are located on the same core. The A suffix indicates that it is an armature circuit saturable reactor and the F, a field circuit saturable reactor.

Voltage Levels

While a-c power and control circuits are usually arranged to be most convenient, d-c control circuits are often

arranged as voltage level indicating diagrams. With a diagram drawn this way, one can tell at a glance the approximate magnitude as well as the polarity of a voltage between two points.

In looking at the d-c electronic control circuit of Fig. 2, which is drawn to indicate voltage levels, it is apparent that line 6 is of a higher positive potential than line 7; that line 5 is higher than line 6—and so on. Diagrams drawn in this manner are really a great help in analyzing circuits of this type.

Wiring Diagrams

Although the elementary diagram is essential in analyzing the circuit and any faults that may develop, its counterpart, the wiring diagram, is just as essential in trying to find the location on the panel of any suspected unit. The wiring diagram shows as nearly as possible the actual physical position of all devices. Since the elementary diagram is intended to show the operation of the entire system, it must include not only the equipment mounted on the panel but also all the external equipment, such as the anode transformer and the motor. The wiring diagram, though, may, for convenience, be broken into several different sections.

The wiring diagram for the equipment shown in the elementary diagram

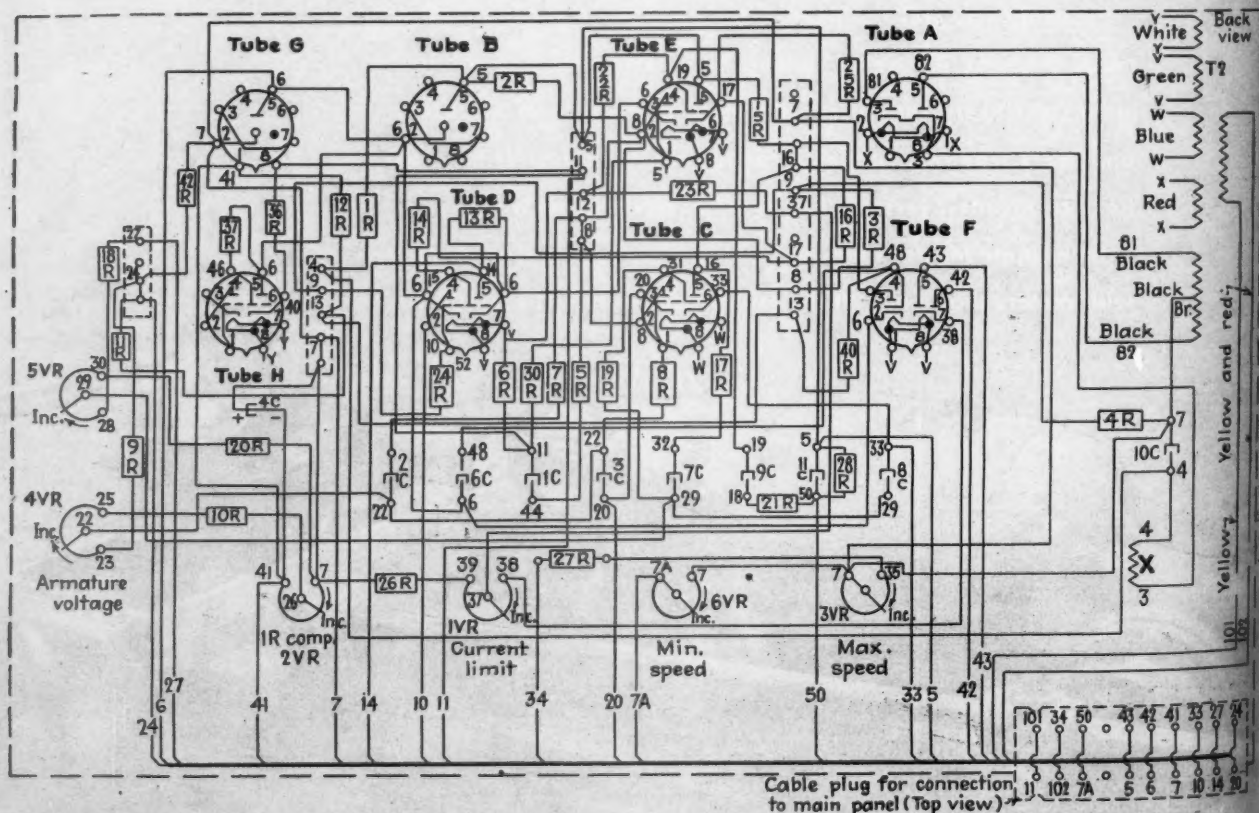
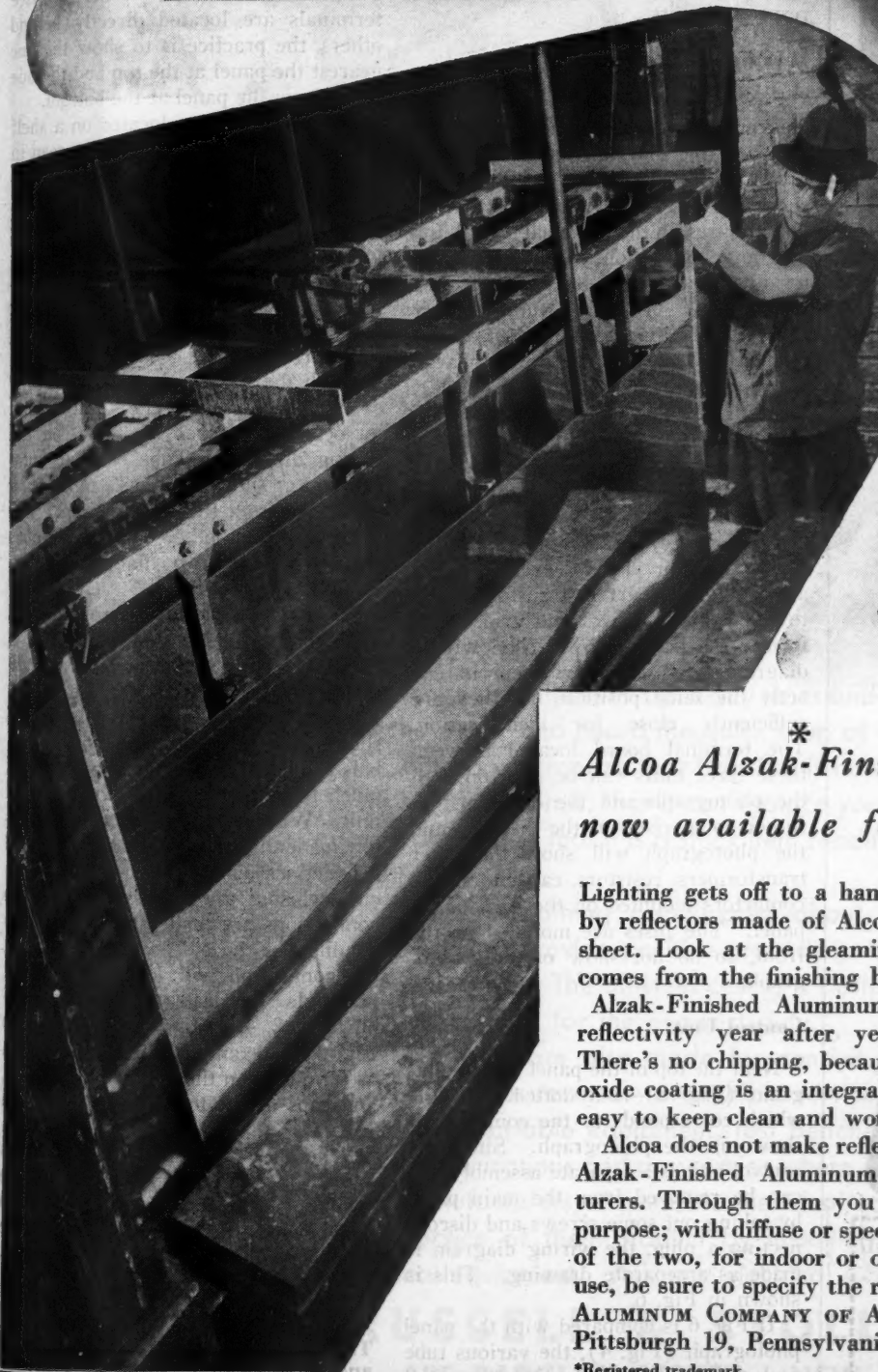


FIG. 6. Wiring diagram of control circuits which are mounted on a subpanel on the main motor control panel. Bases of tube sockets, potentiometers, resistors, capacitors, etc., can be seen in Fig. 4. Front of subpanel with tubes, relay and transformer can be seen in Fig. 5.

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Alcoa does not make reflectors, but supplies top-quality Alzak-Finished Aluminum sheet to reflector manufacturers. Through them you can obtain reflectors for any purpose; with diffuse or specular surfaces, or combinations of the two, for indoor or outdoor work. Whatever your use, be sure to specify the right Alzak finish for each job. ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.

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in Fig. 2 is divided into three parts; the interconnection diagram, the main panel diagram, and the control unit diagram. The interconnection diagram, which was illustrated and described in the last article, is of help in checking troubles external to the panel, as well as in making the initial installation. The main panel diagram and the control unit diagram show the location of the components on the respective units.

Location of Components

Fig. 3 shows the main panel wiring diagram, marked "backview". Let us compare this diagram with the photograph of the back view of the panel shown in Fig. 4. At the bottom of both figures is the terminal board for outgoing connections. Just above the terminal board, from left to right, are: the cathode protective timing relay (TR); the thyatron filament transformer (3T); the thyrite discharge resistor and the field loss relay (FLR). The wiring diagram shows tubes 2, 4, 3, and 1 above these units, but these tubes are mounted on the front of the panel and do not show in the back view photograph.

The photograph shows the field saturable reactor FSX several inches above TR; the current transformer 4T to the right of FSX; and grid transformer 6T below FSX. The wiring diagram does not show them in exactly the same position, but they are sufficiently close for identification. The terminal board located between these three units can be seen on both the photograph and the diagram. A further comparison of the diagram and the photograph will show the other transformers, resistors, capacitors, and contactors mounted on the back of the panel. The fuses are mounted on the front, so do not show on the photograph.

Control Unit

Near the top of the panel wiring diagram (Fig. 3) is a dotted rectangle which corresponds to the control unit shown in the photograph. Since the control unit is a separate assembly and can be removed from the main panel by taking out some screws and disconnecting a plug, the wiring diagram is made as a separate drawing. This is shown in Fig. 6.

If Fig. 6 is compared with the panel photograph (Fig. 4), the various tube sockets, adjusting potentiometers, and the filament transformer can easily be identified. It is a little more difficult to locate the small resistors, but their position may be determined by tracing the connections to the tube sockets, capacitors, potentiometers or terminal blocks as the case may be.

Wiring Diagram Limitations and General Practices

Because a wiring diagram must show on one side of a single sheet of paper not only the material that is located on both sides of a panel, but also the device terminals which may be directly in back of others rather than above or below them, some system must be used which will make a diagram understandable. Where device terminals are located directly behind others, the practice is to show the one nearest the panel at the top and the one away from the panel at the bottom.

Tubes 3 and 4 are located on a shelf in front of the panel and can be seen in the front view photograph, Fig. 6. In this case, again, the terminals nearest the panel are shown at the top and the terminals away from the panel are shown at the bottom.

Tube Connections

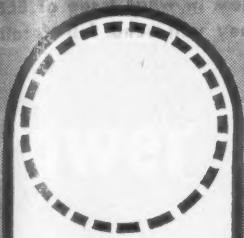
Where all tube connections come through the socket, the tube symbol is easily interpreted. The locating pin on octal type tubes is shown on the wiring diagram. Tube element numbers are as shown in Fig. 5, numbering clockwise from the locating pin. The index mark on other than octal tubes is between the two filament connections.

If connections are brought out through the top or side of tube, or if the tube has no socket at all, a certain amount of imagination must be used in interpreting the tube symbol. Fig. 5 shows both types of tubes. The symbols as shown in Fig. 3, however, look much the same as those in the control unit. Wherever connections are actually made through the socket, the dotted connections appear directly on the circle enclosing the tube symbol. If the connections are made at caps or studs coming out the side or top of a tube, the connection will look like a small rectangle. See leads 66, 62, 57, and 65 on tubes 2, 4, 3, and 1, respectively in Fig. 3, for example. These are shown as terminals on the side of tubes 1 & 2, and caps at the top of tubes 3 & 4 in Fig. 5.

Where the tube itself has leads, as shown on tubes 1 and 2 in Fig. 5, the symbol is shown with the connection dot beyond the circle enclosing the tube symbol. This is shown in Fig. 3, leads 64, 59, 75, and 72F on tubes 1 and 2.

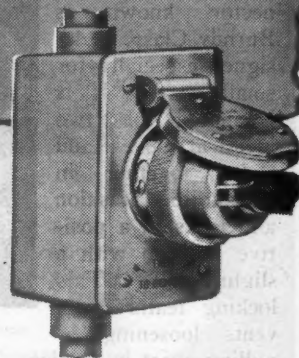
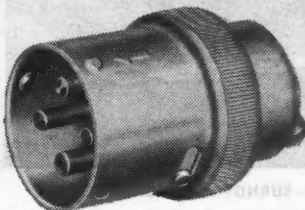
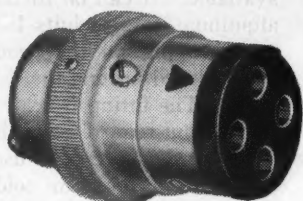
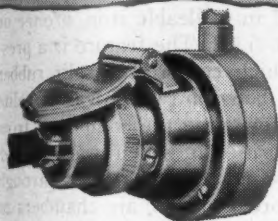
Transformer Symbols and Marking

Transformer leads are almost always colored or marked in some manner for identification. These markings are also shown on the diagram. If the leads are numbered it is important to bear in mind that these numbers may not agree with the panel numbering.

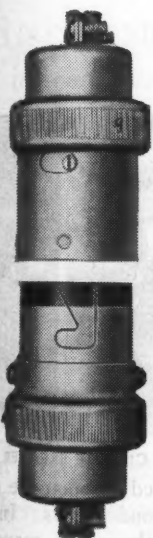


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There is nothing complicated about Ever-Lok. Contacts are self aligning and provide positive grounding. It is impossible to connect up the wrong way. The all-steel casing is dustproof, corrosion resistant and rugged enough for the heaviest duty.

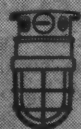
Ever-Loks are also made for conduit, outlet box, flush and floor mountings, for reverse—or multiple service and weathertight if desired. Ideal for portable equipment, test benches, outdoor applications such as communications and any service where interruptions must be avoided.

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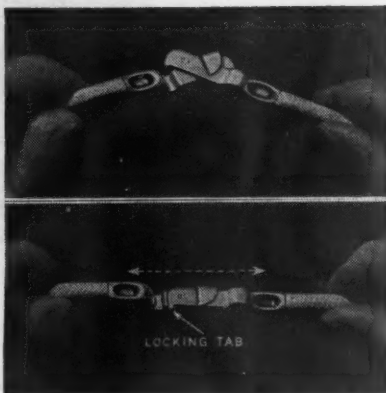


THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of **ELECTRICAL CONTRACTING** you saw the item and they will send full details to you.

EQUIPMENT NEWS

Electrical Connector

This new self-locking quick-disconnect type of electrical connector, known as Burndy Clasp, is designed especially for small wires. It is composed of two identical halves, and slides together in jack-knife fashion and locks in a positive position with a slight pull. This locking feature prevents loosening or pulling apart in service. To lock the clasp, the two halves are crossed, swung into line and pulled slightly to the locked position. It is made of copper and heavily silver-plated, has high electrical efficiency and resistance to corrosion. It utilizes the Burndy Hydent principle for gripping the cable ends. Four clasp connector sizes accommodate 10 sizes of aircraft cable—from No. 18 to No. 8. The two smaller sizes include an insulation grip on the cable sockets, while the two larger sizes are furnished without insulation grips. Burndy Engineering Co., Inc., 107 Bruckner Blvd., New York 54, N. Y.



BURNDY CONNECTOR

Lighting Fixtures

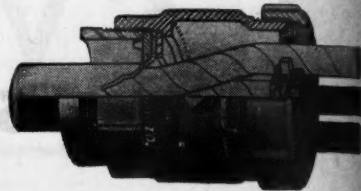
These "One-Point-Five" low bay reflectors are designed to provide adequate, even lighting on spacings as great as 1.5 times the mounting height above the work. Due to the reflector contour and prism design an output efficiency of 90 percent is obtained and a shielding angle of 25 deg. eliminates glare. Three sizes are available to accommodate from 25 to 300-watt lamp. Reflectors are heavy pressed prismatic glass with reinforcing flange at bottom edge. Temporary dirt and dust depreciation is minimum due to the smooth inside reflector surface and the chimney action of the ventilated fitter. Holophane Co.; Inc., 342 Madison Ave., New York, N. Y.



LIGHTING FIXTURES

Cable Terminator

A new type horizontal cable terminator for use with single or multiple cables up to 750 volts and for lead, rubber or braided covered cable is

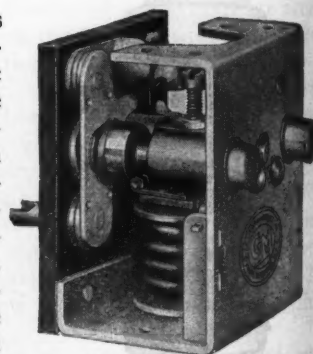


O. Z. TERMINATOR

available. It can be furnished in malleable iron, bronze or aluminum, for conduits 1 in. to 6 in. The feature is a pressure bushing on the head which compresses split rubber rings placed around the cables between two canvas Bakelite disks. The fitting is sealed, preventing the compound from leading out regardless of the position in which it is installed. Also the device can be used on conduits that pass through chambers or rooms in cold storage vaults, air chambers or rooms having non-hazardous gases or fumes. The O. Z. Electrical Manufacturing Co., 262 Bond St., Brooklyn 2, N. Y.


Circuit Breaker

These circuit breakers are designed for the protection of either a-c or d-c circuits. They may be equipped with three separate coil windings which makes a single unit adaptable for protecting equipment designed for operation on different voltages. As they have no appreciable time lag, they are recommended for use with power vibrators or other electronic equipment where it is desired to open the circuit instantly when a predetermined overload occurs. In addition to acting as a resettable fuse, they also serve as a manual switch and they are equipped with independent "on-off" push buttons. The respective windings may have a different number of turns and be of different size wire so proportioned that tripping may occur on overloads of three widely separated values from as low as a fraction of an ampere up to as high as 70 amp. Each winding has an independent terminal connection so that the current value at which the circuit breaker operates is dependent upon the terminal to which the load is connected. For applications having only one circuit value, single coil windings can be supplied. G-M Laboratories, Inc., 4300 N. Knox Ave., Chicago 41, Ill.



G-M. CIRCUIT BREAKER

Good Start for a Power Transformer



Operator at Allis-Chalmers' Pittsburgh plant applying Natvar varnished cambric to form the insulating barrier between core and low voltage winding of a Power Transformer. Multiple strand conductor is used for compactness and for maximum reduction of eddy current losses.

ALLIS-CHALMERS Power Transformers are designed and built for continuity of operation with minimum of maintenance.

In spite of increased industrial loads demanded by the war effort, these transformers have operated far beyond their rated capacity for extended periods without interruption, without other than routine maintenance. *That's performance!*

It is a source of considerable satisfaction to us that Natvar insulating materials, because of their high uniformity, were selected for this important application.

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- Varnished identification markers
- Lacquered tubings and sleeveings
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Power Supply Units

A new line of metal-enclosed, high-voltage d-c power supply units, available in ratings up to 50,000 volts d-c, has been announced. These units provide d-c power for applications such as testing of electric equipment, precipitation, induction heating, radio and miscellaneous industrial and electronic applications requiring a high voltage d-c supply. Each unit consists of a full-wave kenotron rectifier, a filter to limit voltage ripple to one percent or less and complete control equipment, all mounted in a steel cabinet. The four kenotron tubes are mounted in sockets integral with the double conductor, high voltage terminals on the cover of the single oil-filled tank which contains combined main and filament transformers. The d-c output voltage can be controlled, from zero to maximum by means of a motor-operated, dry-type variable autotransformer. All of the meters, indicating lights, and manual controls are located on a recessed panel in the upper section of the cabinet. Among the safety features incorporated in the unit is an automatic solenoid-operated discharge switch. This switch is interlocked with main supply in such a manner that it automatically short-circuits the rectifier and discharges the filter capacitor through a resistor when power is removed. Safety interlocks automatically deenergize the equipment when the cabinet doors are opened. General Electric Co., Schenectady 5, N. Y.

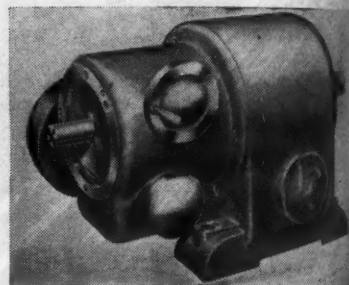


G-E POWER SUPPLY UNITS

a predetermined electrical resistance contacts the probe. While the probe is immersed in liquid of any other resistance, the control remains inoperative, but when a change in concentration alters the conductivity of the liquid to the necessary degree, the electronic control relay is energized to operate signals, valves or pumps. Type P25N has a range of 100 to 5,000 ohms and operates on a five percent change in probe-circuit resistance. The predetermined resistance value for which the control is set remains fixed regardless of variations in line voltage or tube characteristics. It incorporates a single-pole, double-throw relay, rated at 10 amp. a-c, 5 amp. d-c for normally closed and normally open operation, and requires a supply of 115 volts a-c, 60 cycles. Photoswitch, Incorporated, Cambridge 42, Mass.

Variable Speed Drive

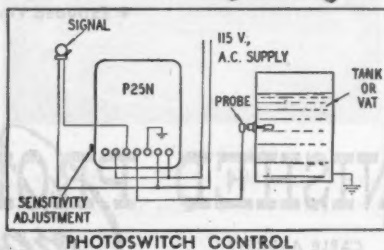
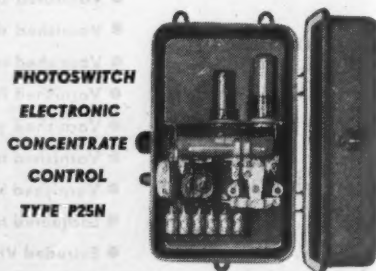
This new variable speed drive consists of simple gearing transmitting the power, and a light V-belt for varying the speed ratio. In the general industrial field as well as in the Lombard specialized power equipment field, the size of this new drive makes it particularly adaptable for the medium and higher horsepower applications. Drives from 1 hp. to 100 hp. or higher, variable speed ratios ranging from 14:1 to 70:0 are available. Low gear ratios are available to give close, accurate control when desired. The drive is about the size of the a-c motor which drives it. Flange mounted motor design also available. The new drive is normally furnished with manual control and wheels or levers but the unit may also be had with remote control. The drive uses the V belt as the control medium only, rather than for both drive and control. Lombard Governor Corp., Ashland, Mass.



LOMBARD VARIABLE SPEED DRIVE

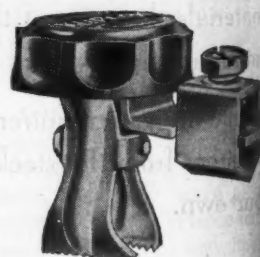
Electronic Control

A new control to check liquid mixtures electronically has been announced. This electronic method provides control for all applications in which changes in concentration are accompanied by a corresponding change in electrical conductivity. Installation is made by a probe fitting mounted on the tank, with probe extending into the liquid. This probe is wired to the electronic control which may be located wherever desired. An adjustment on the control housing is set so that the control relay will operate when liquid of



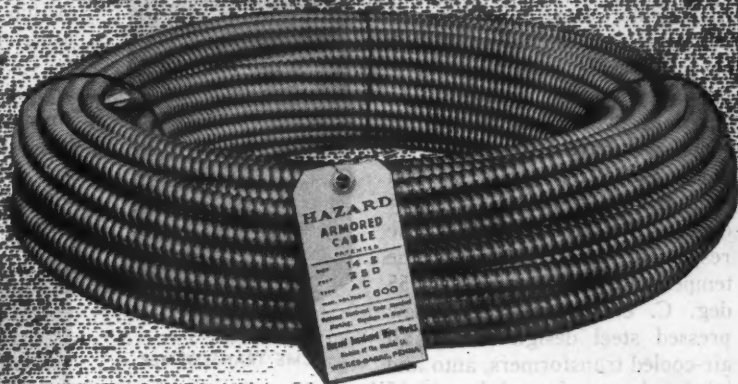
Test Clamps

This new line of test clamp is recommended for making heavy duty temporary connections; motor and meter testing, jumpers, cable and busbar taps, battery charging, welding and many other shop and laboratory purposes. A slight twist of the finger-tip safety knob exerts tremendous pressure, supplying large carrying capacity of 20 to 350 amp. on constant and intermittent duty. Solderless lugs provide quick electrical connections without the use of special tools or cutting into wire; arranged to swivel around clamp, permitting wires and cables to hang in a natural position after installation. It is available in six sizes to fit across ferrule and knife blade fuse clips, switch blades, round or flat busbars, cables, etc. Trico Fuse Mfg. Co., 2948 North 5th St., Milwaukee 12, Wis.



TRICO TEST CLAMPS

code requirements



PLUS...

in HAZARD ARMORED CABLES

Hazard Armored Cables not only meet all Code requirements but go further than Code in the provisions made for safety and ease of installation.

RIP CORD



WATER
PROOF

BUSHING

Galvanized, interlocked steel armor required by Code is conformed to by Hazard in the use of high quality steel. The bushing provided by Hazard has a little patented lock for easier handling.

Moisture and flame retarding braid required, is made by Hazard of strong, long-fibre, evenly woven cotton braid.

Paper protective sheath over conductors is required by Code. Moisture proofing of paper is a Hazard *plus*.

Another Hazard *plus*, not required by Code, is the Rip Cord which simplifies the removal of the paper sheath and helps to make a clean installation.

Approved rubber insulation on conductors is required by Code to withstand a temperature of 122° F. Hazard's Performite insulation (at a slight additional cost) provides greater carrying capacity and greater safety by allowing a temperature of 167° F. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.



HAZARD



INSULATED WIRES AND CABLES FOR EVERY ELECTRICAL USE

3914

Transformer

The weight of these air-cooled transformers have been reduced an average of 22 percent, by the use of pressed steel for covers, instead of steel castings. In addition, overall dimensions in some sizes have been reduced as much as 4½ in. It is claimed that the redesign in no way effects the rated output of the respective units and that the temperature rise remains at 55 deg. C. continuous. The new pressed steel design covers all air-cooled transformers, auto and insulated types from 1 kva to 15 kva with primaries up to 2400 volts. Acme Electric & Mfg. Co., Cuba, N. Y.



ACME TRANSFORMER

Infra Red Lamp

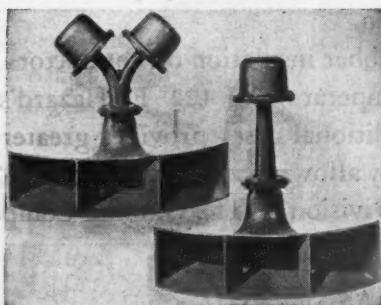
A new principle in control of wavelength by a ceramic coating on the lamp has been brought to the infra-red field. Research has proved that more intensive color, better curing and superior polymerization on metals results from its improved wavelength. Penetray's amber coating reduces glare. It also reduces attraction to insects thus insuring clean work. Lower lamp base temperature is another advantage. In metallic finishing, better gloss shows significant advantages in corrosion and abrasive tests. Verd-A-Ray Corp., 615 Front St., Toledo, Ohio.



VERD-A-RAY PENETRAY

Loudspeaker

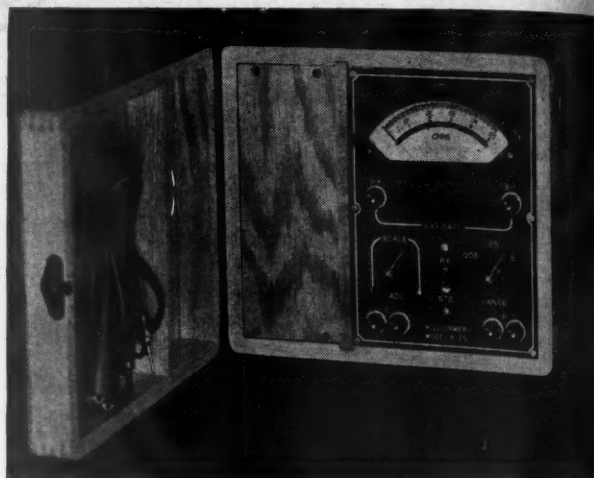
A new loudspeaker, Type 26-B, designed to operate through high noise levels and with uniform distribution over horizontal angles of 120 and vertical of 40, has been announced. It is designed for voice reproduction when used by itself or as a high frequency component to a wide range system. The unit is cast aluminum, equipped with heavy universal mounting brackets, and is designed for economy of installation. It handles power input of 40 watts when equipped with two Jensen U-20 drive units. Dimensions are 22 in. wide, 14½ in. deep and 20 in. high. The Langevin Company, 37 W. 65th St., New York 23, N. Y.



LANGEVIN LOUDSPEAKER

Instruments

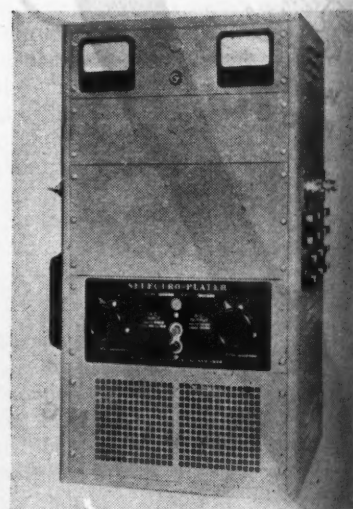
The new Model P-25 linear scale mill-i-ohmer measures switch resistance, contact resistance, fractional ohm, standards, etc. The range of the scale is 1/20,000th of an ohm to ½ ohm. It operates on self-contained battery. Unit is housed in heavy-duty oak cabinet. Mirror scale on meter eliminates Parallax enabling extremely accurate readings. It has three ranges 0 to .005/.05/.5 ohms. The built-in standard resistors are all of the 4 terminal type and are individually adjusted to an accuracy of ½ of 1 percent. Superior Instruments Co., 227 Fulton St., New York 7, N. Y.



SUPERIOR MILL-I-OHMER

Multi-Rectifier

This newly developed multi-rectifier incorporates six selenium rectifier sections which may be interconnected by external links to provide four ranges of d-c power. They are 0 to 8 volts, maximum capacity 100 amp.; 0 to 16 volts, 50 amp.; 0 to 24 volts, 35 amp., and 0 to 48 volts, 18 amp. It is possible for the two panel-mounted voltage control switches to provide



GREEN RECTIFIER

a range of control in 49 steps, from zero to maximum on any range. The built-in voltmeter and ammeter indicate the d-c output voltage and current at all times, and red line calibrations indicate the maximum current limitation on each range. Other features are 3-phase magnetic contactors in power supply circuit with on and off push buttons, pilot lamp, monitor lamp, buzzer and automatic watchman which provides automatic current interruption in case of prolonged overload. The unit is available for operation from 220 to 440 volts or as specified at 60 cycles. Green Electric Laboratories, 130 Cedar St., New York 6, N. Y.

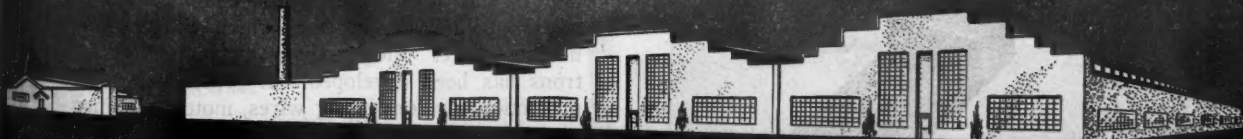
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Superior

Announcing..

PLANT NUMBER TWO

The New Daylight Plant of Lighting Products, Inc., equipped to perform all operations in the production of Finer Fluorescent Fixtures, will be opened this month.

With this addition to our previous facilities, delivery of the 1945 Line of L.P.I. Luminaires will be greatly increased as rapidly as the release of strategic materials permits. Watch for these new L.P.I. Fixtures now in production.

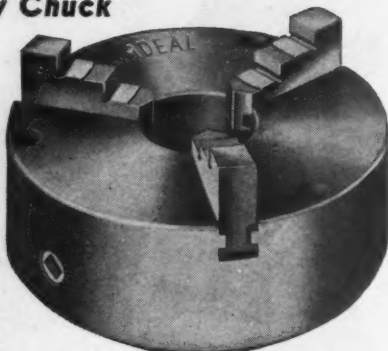


LIGHTING PRODUCTS INC.
HIGHLAND PARK — ILLINOIS

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220 to
Electric

Universal 3-Jaw Chuck

A new Universal three-jaw chuck supplements this line of machine tool accessories. It is precision made to assure accurate turning. The body is of fine grain, high tensile strength semi-steel. Ample resistance to shock, load and unusual stress is provided by rib construction. Two sets of jaws are furnished, one for internal and the other for external work. The jaws are made of specially treated alloy steel to give toughness and strength. If one jaw is damaged, it can be readily replaced. The scroll is made of alloy steel and has heavy proportions to assure true turning and long life. It is available in the 5-in. size only. A mounting adaptor is furnished with each chuck so that it may be fitted to the particular lathe on which it is to be used. Ideal Commutator Dresser Co., 1041 Park Ave., Sycamore, Ill.



IDEAL CHUCK

Explosion Proof Motor

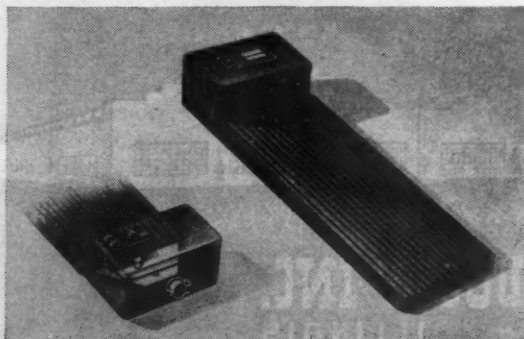
A new explosion proof motor for operation in Ethyl ether vapors, Class I, Group C, is available. This motor is constructed to meet the specifications of and carry the label of Underwriters Laboratories, Inc. for installations where the surrounding atmosphere is charged with Ethyl ether vapor. This is in addition to other explosion proof motors for other hazardous locations. Century Electric Co., 1806 Pine St., St. Louis 3, Mo.



CENTURY MOTOR

Foot Switch

A new foot switch, designated as Model "MF", is for actuating one-way circuits. The foot rest is $\frac{1}{2}$ in. above the floor and it requires $\frac{1}{8}$ in. throw. This allows the operator to support his whole foot nearly at floor level, thereby reducing fatigue. It is splash and dust proof so that factory



GENERAL CONTROL SWITCH

conditions cannot affect its life or limit its applications. General Control Co., 1200 Soldier Field Road, Boston 34, Massachusetts.

Fluorescent Lamp Starter

This new gas-actuated fluorescent lamp starter is called the "Glostat FS-5", for the 4-, 6- and 8-watt fluorescent lamps. Starter contacts, which are normally open, are enclosed in a low-pressure argon gas atmosphere. Stationary contact consists of a rectangular metal "flag" to assure electrical make and break with a short silver bar spot-welded to movable bimetal element. When the line switch is closed, the argon gas glows and heats the bimetal element which momentarily closes the circuit to preheat the lamp cathodes. The voltage drop across the lamp prevents recycling while the lamp is in operation. Closing of the starter contacts also eliminates the gas glow in the starter so the movable element can cool and return to its normal position and permit the establishment of the arc in the fluorescent lamp. Sylvania Electric Products, Inc., Salem, Mass.



SYLVANIA STARTER

Safety Ladder Shoe

A safety shoe designed to fit any standard ladder rail is equipped with a spike toe for outdoor use and rubber treads for indoor floors. Side plates of No. 13 gauge steel are easily attached to the ladder with three bolts. The edge of the base is set with steel spikes which are brought into use by rotating the shoe on a bolt hinge. Rubber treads with suction grip are set in the base which holds the ladder securely on indoor floors. These ladder shoes are listed by Underwriters Laboratories, Inc. Dayton Safety Ladder Co., 2334 Gilbert Avenue, Cincinnati, Ohio.



DAYTON LADDER SHOE

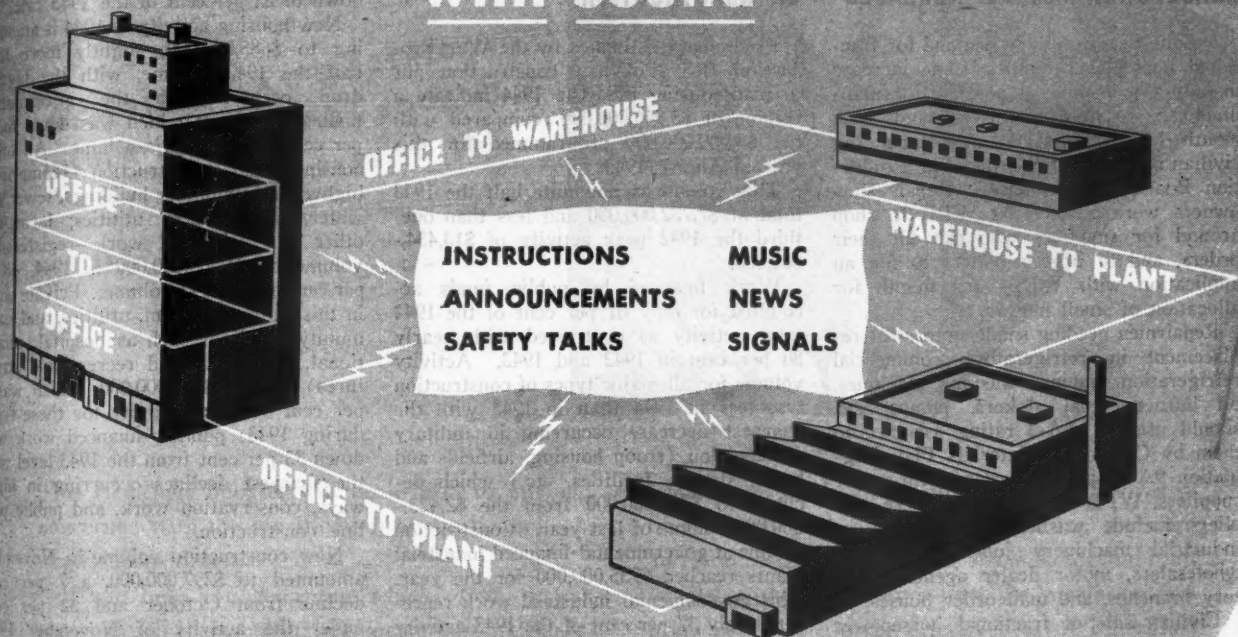
Midget-Fuse Plug

To meet the requirements for universal motors and other single phase equipment, a 2 wire, 3 pole Ever-Lok plug which will accommodate either midget fuses or midget fuses-trons has been developed. It provides circuit protection for connecting wires, motor winding protection and a disconnect and automatic locking feature with safety and grounding features. The plug is smaller than similar Ever-Loks made for standard N.E.C. fuses. Also available in 3 wire 4 pole for 3 phase machines. Surface and flush mounting receptacles and cord connectors are available. Russell & Stoll Company, 125 Barclay Street, New York, N. Y.



FUSE PLUG

Increase Operating Efficiency in Commercial Buildings with Sound



An RCA Sound System conserves valuable time and energy by providing instant communication between executives, key personnel, and workers in office, warehouse, and factory areas.

In addition, sound is a new practical utility that permits wide flexibility in the planning of working space. It eliminates the need for placing together related departments or even workers on a connected job. For properly controlled communication between operating departments, design a sound system into all business and industrial buildings. Write Radio Corporation of America, Sound Equipment Section,

Box 70-135E, Camden, New Jersey, or call in an RCA Representative.

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Indicate RCA Equipment.**

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FREE BOOKLET

A copy of "Manpower, Music and Morale" will be sent you free, on request. It contains important data on the use of sound in business and industry. Write Dept. 70-135E, Sound Equipment Section, Radio Corporation of America, Camden, New Jersey.

IN THE NEWS

OUTPUT OF FRACTIONAL HORSEPOWER MOTORS INCREASED

Despite heavy military demand for fractional horsepower motors, some increase in output is making it possible for manufacturers to ship several thousands each month for the most essential farm and civilian replacement use, the War Production Board has announced. Repair shop owners were advised by WPB to shop around for suppliers who can fill their orders, and to urge suppliers to file an application with WPB each month for allocation of small motors.

Repairmen needing small motors for replacement in refrigerators, commercial refrigeration systems, washing machines, oil burners, coal stokers, pumps, etc. should use the AA-3 rating assigned to them by Controlled Materials Plan Regulation 9A in placing orders with motor suppliers, WPB officials said. These suppliers include washer, refrigeration or industrial machinery jobbers, electrical wholesalers, motor dealer agencies, factory branches, and mail order houses.

Civilian sale of fractional horsepower motors is restricted to the most essential uses, because of the relatively small number available for non-military purposes, WPB officials pointed out. Clarification of procedure to aid both repairmen and suppliers in obtaining small motors follows:

1. Suppliers who have fractional horsepower motors in stock are required to fill repair shop orders carrying AA-3 ratings if the motors are not needed to fill higher rated orders. The buyer, however, must meet the seller's regularly established prices and terms of sale.

2. Suppliers are not permitted to demand an old motor in exchange for a new one as part of the purchase price on orders with AA-3 ratings.

3. Motors may be sold only on rated orders, except when needed for replacement of disabled motors. In such cases, the old motor must be taken in exchange, repaired if practicable, and re-sold under similar conditions.

4. Suppliers who are regular sellers of fractional horsepower motors should file Form WPB-54 each month stating one month's requirements, instead of at irregular intervals. They will thus place themselves in a better position to obtain their share of the supply available for civilian use, since motors are allocated on a month to month basis. This is considered the best procedure for equitable distribution through jobbers and dealers.

5. Small motors are allocated and ratings for their purchase are assigned only to firms that have regularly carried such motors in stock.

WPB REPORTS ON CONSTRUCTION

Preliminary estimates by the War Production Board of new construction put in place during the year 1944 indicate a volume of \$3,840,000,000, compared with the \$3,900,000,000 programmed for this year in August 1943.

This volume is not quite half the 1943 total of \$7,732,000,000 and less than one-third the 1942 peak activity of \$13,434,000,000.

Work financed by public funds accounted for only 61 per cent of the 1944 total activity as contrasted with nearly 80 per cent in 1942 and 1943. Activity volume for all major types of construction was less in 1944 than in 1943 with the sharpest decrease occurring in military construction (troop housing, airfields and bases, storage facilities, etc.) which declined to \$730,000,000 from the \$2,423,000,000 volume of last year. Construction volume at governmental-financed industrial plants reached \$735,000,000 for the year. This governmental industrial work represents only 37 per cent of the 1943 activity of \$1,973,000,000 and 21 per cent of the \$3,485,000,000 factory volume of 1942.

Deliveries of machinery and equipment to government-financed plants in 1944 were down to 35 per cent of the 1943 rate.

New housing activity in 1944 is amounting to \$685,000,000, slightly more than half the 1943 volume, with the biggest drop occurring in the government-financed segment which was down to 27 per cent of last year's volume. All other non-industrial construction—comprising highways, community buildings, sewer and water, conservation, utilities, farm and other non-residential work—registered a volume of \$1,505,000,000 in 1944, or 84 per cent of the 1943 volume. Private work in this category (farm, utilities, and community buildings such as hospital, educational, and social and recreational structures) totaled \$804,000,000, which was 8 per cent over the activity for these types during 1943; publicly-financed work was down 33 per cent from the 1943 level with the sharpest declines occurring in highways, conservation work, and public pipe line construction.

New construction volume in November amounted to \$297,000,000, a 7 per cent decline from October and 32 per cent under the activity of November 1943. Military and government-financed industrial construction during the month con-



Here's information you can use, NOW!

**New FIBERGLAS* ELECTRICAL
INSULATION MATERIAL BOOKLET
... TELLS WHAT TYPE TO USE,
WHERE AND HOW ...**



This free, new booklet will be helpful to anyone concerned with the specification or application of electrical insulation.

It will help you determine which of the many types of Fiberglas electrical insulation materials should be used for a specific job.

The booklet will show you where this better insulation material can be used advantageously for electronic, radio and electrical applications.

It will indicate the ways to use Fiberglas electrical insulation material to obtain all of the benefits which it affords.

Containing complete information about Fiberglas, the new booklet illustrates Fiberglas fibers and filaments twisted into yarns, served on wires, woven into tapes and cloths, braided into sleeveings and formed into tying cords.

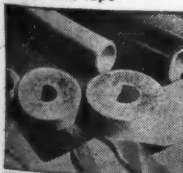
It describes the unique combination of elec-

trically and mechanically important characteristics of Fiberglas such as: high temperature, moisture and acid resistance, favorable space factor and high tensile strength. It shows how the insulating impregnants increase the effectiveness of Fiberglas' inherent characteristics and add others such as high dielectric strength, insulation resistance and resistance to abrasion.

You will see why the use of this basic, inorganic, insulating material is increasing so rapidly—why so many designers, manufacturers and repair shop operators prefer it.

Be sure to have a copy of this new booklet in your file for ready reference. Write for your copy today—there is no obligation. Address: *Owens-Corning Fiberglas Corporation, 1856 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

Fiberglas varnished cloth and tape



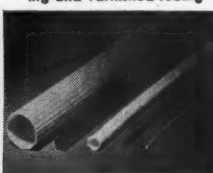
Fiberglas insulated wire



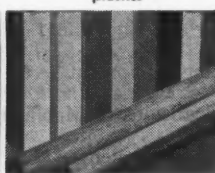
Fiberglas tying cord



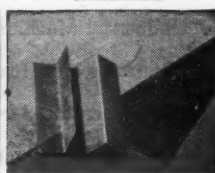
Fiberglas saturated sleeveing and varnished tubing



Fiberglas laminated plastics



Fiberglas-mica combinations



FIBERGLAS

*T.M.Reg. U.S. Pat. Off.

ELECTRICAL INSULATION MATERIAL

tinued at the October levels but housing, privately-financed industrial and other types, registered seasonal declines. Overall activity during December is expected to decline 11 per cent from the November level.

Should "Victory in Europe" Day come in the Spring, preliminary estimates indicate a volume of approximately \$4,000,000,000. However, should both theatres of war continue at full force throughout the year, it is anticipated that construction activity will amount to about \$3,150,000,000, WPB stated.

WPB RELEASES STATISTICS ON CONTROLLED MATERIALS

This is the first public release by the War Production Board of statistics on the use and inventories of the controlled materials—steel, copper, and aluminum—by

metal-products industries as reported on Form WPB-732. It is intended to inform industry where these three critical metals have been allocated. The complete report has been tabulated from nearly 10,000 reports of private and government-owned manufacturing plants engaged in fabricating or assembling metal products.

The data represent only a part, although a major part, of the total consumption and inventories of steel, copper, and aluminum produced in the United States.

Salient statistics showed that the reporting plants consumed in the first quarter of 1944 a total of 9.9 million tons of carbon steel, 1.4 million tons of alloy steel, 1,534 million pounds of copper and copper-base alloys, and 505 million pounds of aluminum. Total usable inventories of these metals at the end of the quarter represented 81, 77, 44, and 83 percent, respectively, of the quantities used during the quarter. Usable inventories at the end of the quarter did not vary by more than 5 percent from those at the begin-

ning of the quarter; inventories of carbon steel and aluminum increased and those of alloy steel and copper and copper-base alloys decreased.

The production of combat material required 4,230,707 tons, or 43 percent of the carbon steel reported used in the quarter; 681,399 tons, or 48 percent of the alloy steel reported; 939,133,000 pounds, or 61 percent of the copper and copper-base alloys; and 428,717,000 pounds, or 85 percent of the aluminum. Although not strictly comparable to production, the value of combat-material shipments in the same period was 57 percent of total shipments. A large proportion of "intermediate" and "component" products, not classified as "combat materiel", is nevertheless incorporated in combat-material products.

Steel was more widely used in manufacture than any of the other metals. However, over one-fourth of the carbon steel was consumed directly in the manufacture of ships and ship equipment and about one-

USE OF SELECTED METALS IN MANUFACTURE, BY TYPE OF PRODUCT FIRST QUARTER, 1944

Class of Product	Metals Used During 1st Quarter 1944				
	Value of 1st Quarter Shipments (\$1,000's)	Carbon Steel (Short Tons)	Alloy Steel (Short Tons)	Copper & Cop. Base Alloy (1,000 Lbs.)	Aluminum (1,000 Lbs.)
Combat Materiel — 1.....	10,461,938	4,230,707	681,399	939,133	428,717
Ammunition.....	1,044,535	888,633	119,069	802,267	12,289
Guns and Fire Control Equipment.....	821,038	121,807	96,998	23,381	4,395
Combat Vehicles.....	845,807	273,811	206,909	5,489	1,821
Aircraft, Parts, and Equipment.....	5,354,618	314,896	178,940	32,227	405,759
Ships and Ship Equipment.....	2,395,940	2,631,560	79,483	75,769	4,453
Communication and Electronic Equipment — 2.....	1,049,298	34,475	10,614	28,941	11,166
Intermediate Products and Components — 3.....	2,483,908	1,509,860	294,490	377,673	37,230
Insulated wire and cable.....	38,426	1,917	45	167	26
Carbon brushes for electrical equipment.....	7,241	7	3	467	.....
Pole line hardware and insulators.....	6,297	15,320	2	654	3
Electric wiring devices and conduits.....	75,970	36,074	353	10,745	2,795
Motor and generators.....	188,549	65,615	40,382	38,105	1,962
Internal combustion power generators.....	53,313	5,701	3,504	2,987	309
Steam engine and turbine generators.....	15,886	4,416	1,087	737	19
Power and distribution transformers.....	17,219	7,591	6,091	6,250	2
Fuses.....	3,933	203	2	1,538	2
Switch gear, circuit breakers & motor control eq.....	136,385	32,995	1,255	17,099	256
Electric apparatus for internal combustion engs.....	204,770	39,951	7,520	16,324	4,787
Batteries, storage.....	35,473	895	.....	467	292
Batteries, dry cell.....	18,032	587	.....	280	.....
Power capacitors — static condensers.....	3,388	275	.....	92	242
Transportation Equipment — 4.....	1,088,470	1,014,523	162,734	26,786	8,374
Industrial Machinery and Equipment — 5.....	1,318,662	932,415	147,404	45,604	4,327
Plumbing and Heating Equipment — 6.....	71,408	102,249	2,458	6,660	581
Consumer and Service Industry Machinery — 7.....	115,728	37,013	2,126	4,195	345
Safety and Technical Equipment — 8.....	274,197	28,435	4,783	30,025	1,295
Miscellaneous Metal Products — 9.....	748,060	1,870,366	50,169	41,212	8,014
Lighting fixtures and equipment.....	21,081	4,821	944	2,190	78
Incandescent lighting fixtures.....	8,029	1,945	111	1,317	35
Fluorescent lighting fixtures.....	6,990	1,234	802	524	3
Light fixtures: street, highway & traffic control.....	423	127	20	19	13
Searchlights, floodlights & spotlights (exc. AA).....	2,995	699	1	152	25
Flashlight cases and portable electric lanterns.....	1,685	572	10	92	3
Lighting equipment, not elsewhere classified.....	959	244	.....	86	.....

MEET THE DEMAND WITH

ILLINOIS

COMPLETELY INSULATED

ALL PORCELAIN WIRING SYSTEMS...

PORCELAIN CONFORMS TO THE NATIONAL ELECTRIC CODE



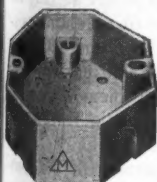
TOGGLE SWITCH
PLATE



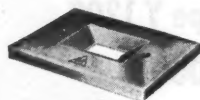
Look for this
Trade Mark



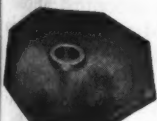
STANDARD TUBES



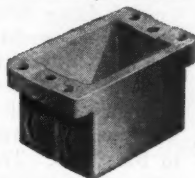
STANDARD KNOBS



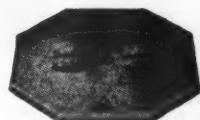
SWITCH BOXES
AND COVERS



OUTLET BOXES AND
COVERS



CLEATS



DUPLEX
RECEPTACLE COVER

★ Contractors everywhere know that Porcelain in large quantities is available—that, therefore, they can do wiring jobs today with no let down in wiring quality—that they still can assure customers of permanency, dependability, and economy—that simplified modern installations are the result of the use of All Porcelain Wiring Systems.

This all means continued business for you—wiring goes right along—porcelain products are in demand. So, as those calls come to you for porcelain, be sure you are prepared with ILLINOIS PORCELAIN.

No vital materials go into the production of porcelain, materials do go into porcelain that make these systems durable—that are not affected by rust or corrosion—that make possible full safety—that make these systems valuable where there is dampness and fire hazard.

Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts. They can be installed without grounding.

Illinois

ELECTRIC PORCELAIN CO.

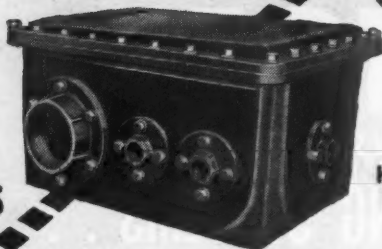
MACOMB, ILLINOIS

O.Z. JUNCTION BOXES

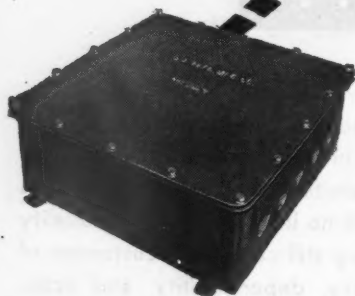
WEATHER PROOF BOXES Type Y 3200



CAST IRON JUNCTION OR PULL BOXES



HEAVY DUTY EXPLOSION RESISTING BOXES Type Y 6000 A



HEAVY DUTY WATERTIGHT BOXES Type Y 6000 B

OTHER TYPES AVAILABLE NOW ARE:

UNFLANGED RECESSED-COVER BOXES—Type Y 6200

FLANGED RECESSED-COVER BOXES—Type Y 7000

UNFLANGED JUNCTION OR PULL BOXES—Type Y 1200

FLANGED OR FLUSH BOXES—Type Y 8000

RECESSED SIDEWALK BOXES—Type Y 5800

FLUSH TRIM BOXES—Type 8200

This complete line of O.Z. Cast Iron Junction Boxes is enjoying an ever-increasing usage in the building of railways, subways, docks, bridges, industrial plants, highways and underground systems. Constructed of close-grain iron castings, these sturdy boxes are made with the same attention paid to quality and detail that has always been associated with O.Z. products.



Boxes are drilled to your specifications. Send for drilling template pads and also for catalog showing wide range of sizes along with complete data on Conduit Fittings... Cable Terminators... Solderless Connectors... Power Connectors... Grounding Devices. You'll get prompt and efficient service.

O.Z. ELECTRICAL MFG. CO.
262 BOND STREET • BROOKLYN, 2 N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

seventh of the alloy steel was used for combat vehicles. Almost two-thirds of the copper and copper-base alloys was incorporated in ammunition of all kinds. Over four-fifths of the aluminum was consumed directly in aircraft and aircraft parts and equipment.

The tabulation on page 138 indicates the relative dollar value of the various classes of products and their importance as consumers of controlled materials.

Only a part of the compiled statistics are reproduced here.

ADEQUATE WIRING BUREAU PLANS DISPLAY

Over 2,000 Home Builders are expected to attend the Convention and Exposition of the National Association of Home Builders at the Sherman Hotel, Chicago, January 15-18, to bring themselves up-to-date on materials, equipment and techniques which are ready now, or will be ready for the resumption of home construction. The slogan of the Convention is "Back to School for Postwar Builders."

George F. Nixon, chairman of the Convention Exposition Committee, told the Presidents and Secretaries of the National Association's local chapters at their quarterly meeting in Washington, D. C., this Fall: "No member will be qualified to build postwar homes unless he attends the January Exposition and Convention."

In keeping with this philosophy, the National Adequate Wiring Bureau will participate in this show, in order that builders in attendance who are seeking information which will be of practical assistance in postwar home building activities, may see how Adequate Wiring will help to solve their postwar problem of meeting public demand for automatic features in all sizes and types of homes.

One of the major features of the Convention and Exposition will be an announcement and display of the six prize-winning home designs submitted in competition by members of the N.A.H.B., in order to focus attention on the best in pre-war home design, which, the home builders state, will "set the pace" for postwar home construction for the next five to ten years. The occupational classifications used as a problem for the first time in a national contest are: The Farm Home, The City Home, The Suburban Home, The Industrial Worker's Home, The Summer Home and The Home for Two (the Veteran's Home). Special permission has been given to the National Adequate Wiring Bureau, as a strictly service organization, to feature Adequate Wiring layouts for these six homes in its exhibit. It is believed that the Bureau may be the only exhibitor permitted to use these designs.

In addition to the wiring layouts, the Adequate Wiring Exhibit will demonstrate the electrical sales features gained for each home by Adequate Wiring. Emphasis will be given to advantages of Certified Adequate Wiring, in those areas having Certification licenses.

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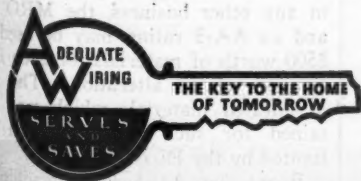
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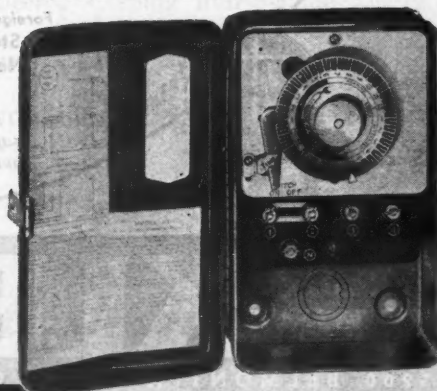
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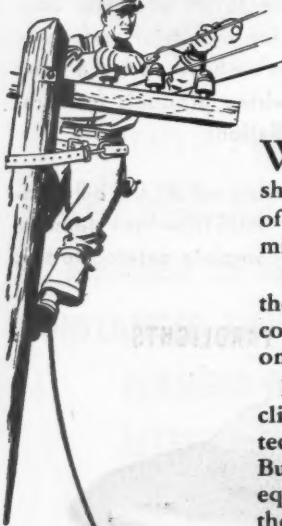


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A number of electrical industry executives from utilities, leagues and the like have indicated their intention of attending the show in company with builders from their territories. While this display is being financed by the National Adequate Wiring Bureau, electrical industry groups around the country which are now preparing to resume active Adequate Wiring promotions, are urged to look upon the Bureau's display at the N.A.H.B. Convention as *their* representative for builders attending from their areas.

Following the Convention, a few changes will be made in the display, to make it applicable to consumers as well as to builders. The display will then be made available, on an itinerant basis to electrical industry organizations for use in their own show rooms, in regional meetings with builders, architects, and home financing agencies, and the like. Details of this arrangement will be announced soon.

INTERPRETATIONS 11 AND 12 TO ORDER L-41

The War Production Board has issued Interpretations 11 and 12 to Conservation Order L-41 (Construction).

Interpretation 11 clarifies provisions governing building alterations that may be made in connection with installations of machinery or equipment permitted under Direction 2 of the order.

The interpretation states that the alterations which can be made without WPB permission are only such as are directly required in connection with the installation or operation of the machinery or equipment being installed. Alterations not directly required in connection with the installation or operation may not be made under the Direction.

For example, new walls or partitions may be put in where required for the operation of the machinery or equipment, but the installation of offices, office partitions, storage rooms, toilets, etc., are not permitted except by specific WPB approval.

The interpretation further points out that the Direction does not limit the cost of building materials which may be used in connection with the installation of machinery or equipment to be used in a business designated on List A of Controlled Materials Plan Regulation No. 5; on Schedule I or II of CMP Regulation No. 5A; or in a business given priorities assistance by any P or U order for maintenance, repair or operating supplies. However, in the case of machinery or equipment to be used in any other business, the MRO symbol and an AA-5 rating may be used to get \$500 worth of materials for each installation or related alteration. The amount of unrated materials which may be obtained for such an installation is not limited by the Direction.

Processing or service machinery or equipment may be installed in an existing building regardless of how the equipment is obtained. However, building service equipment (plumbing, heating, lighting fixtures and the like) may only be installed

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In the meantime, we are making every effort to serve the lighting industry to the best of our ability. We are trying to maintain in stock as many standard catalog items as possible to meet your requirements.

During the past four years the laboratory, engineering and production staffs of Corning have learned a great deal in solving problems important to the war effort. All this valuable information turned to the task of designing and producing lighting glassware is bound to produce outstanding results.

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The use of Corning engineered lightingware is gaining increased customer acceptance—and, Corning research and development will assure a continuation of our leadership in the field of illuminating glassware.

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The quality of G-E Fuses is equal to the finest wiring workmanship. Use them for added evidence of the quality of the work you do. Many kinds and sizes are available from enclosed cartridge fuses with 600 ampere capacity to plug fuses with only three ampere capacity. The G-E fuse line includes:

Non-renewable enclosed fuses, either indicating or non-indicating with 1 amp. to 600 amp. capacity, 250 or 600 volts.

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Silvend fuses with silver-plated contacts with 3 amp. to 600 amp. capacity, 250 or 600 volts.

Pyrex plug fuses* with 3 amp. to 30 amp. capacity, 125 volts.

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GENERAL ELECTRIC

when obtained by means of an approval on a special application form such as WPB-541, WPB-542, or WPB-1319. Building service equipment not obtained through approval of a special form may not be installed under Direction 2.

Plumbing and Heating equipment not included on List A of Limitation Order L-79 (Plumbing, Heating and Cooking Equipment) is normally obtained without any application to WPB and cannot, therefore, be installed under Direction 2 of Order L-41.

If plumbing and heating equipment included on List A of Order L-79 is to be installed in a residence, application may not be made on WPB-1319, but must be made on Form WPB-2896 (Application for Residential Construction Under Order L-41) and filed with the Federal Housing Administration. Approval of this housing application gives the applicant authority for the needed alterations or new construction.

Plumbing and heating equipment which cannot be obtained on a special form and therefore cannot be installed under Direction 2 may be installed to the extent permitted under the annual allowance given by Order L-41 or by other provisions of that order. If an installation is not permissible under L-41, an application under that order should be filed in the usual manner.

Interpretation 12 to Order L-41 has been issued to clarify provisions of the order that deal with the annual cost limits under which construction may be performed without War Production Board permission.

The interpretation points out that the exemption applies only to jobs having a total cost within the annual allowance granted for the various types of construction permitted under the order.

A single job having a total cost greater than the appropriate annual allowance may not be done partly in one year and partly in another year, or partly by one owner and partly by a new owner.

The interpretation points out that the annual allowance applies to all jobs done on the same building or unit in the same calendar year and a new allowance may not be computed if the building changes ownership or a different contractor is employed.

REVISED WIRING HANDBOOK BEING PREPARED

The Industry Committee on Interior Wiring Design, which is representative of all branches of the electrical industry, was re-organized in May of this year, and at that time was authorized to review the Handbook of Interior Wiring Design.

The Technical Committee, with A. Carl Bredahl of Westinghouse Electric and Manufacturing Company as chairman, was assigned the task of revising the existing standards. Two subcommittees have been at work for several months revising the standards on Residence Wiring Design, and, also, developing a standard on Farmstead Wiring Design.

The full Technical Committee was



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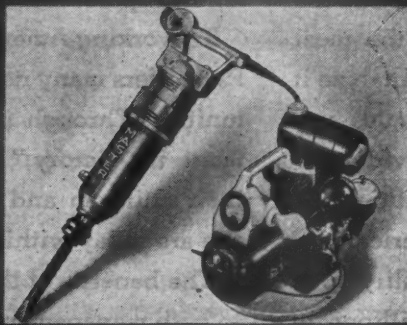


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FOR CUTTING concrete and other materials. For vibrating, tamping, chipping steel, cast iron and wood...scaling and caulking...peening welds and other heavy work.

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called to meet in December to act on the proposed new wiring standards prepared by the subcommittees.

Subject to the action taken by the Technical Committee, the main committee expects to meet some time early in 1945 primarily for the purpose of acting on the newly developed standards. E. A. Brand of the Buffalo, Niagara, and Eastern Power Corporation is chairman of the main committee.

ACTION TAKEN FOR NATION-WIDE APPRENTICE TRAINING

Action was taken at the final session of a meeting of the National General Committee on Apprenticeship for the Construction Industry to expand the nation-wide apprentice training program in the building trades for returning veterans and other American youth. Attending the meeting held in Washington, D. C., were representatives of major national and international trade unions and national employer associations in the various branches of the construction industry, as well as the U. S. Chamber of Commerce and the Associated General Contractors. Also present as consultants were Edward M. Claude, Special Agent, Trade and Industrial Education, U. S. Office of Education, and representatives of other Federal Government agencies concerned with training.

Marion H. Hedges, Director of Research, International Brotherhood of Electrical Workers, presided. The conference was held under the auspices of the U. S. Apprentice-Training Service, War Manpower Commission.

William F. Patterson, Director, Apprentice-Training Service, WMC, addressed the meeting. He stressed the importance of the construction industry giving its best thought and effort to the problem of training apprentices for craftsmanship in the building trades for the postwar era, and particularly that of providing opportunities to returning veterans for apprentice training to equip them for careers in the construction industry.

Resolutions adopted called for efforts to coordinate more closely than ever before the activities in the different branches of the construction industry in expanding the national apprentice training program; for widespread extension of trade training under the sponsorship of joint apprenticeship committees, representative of labor and management, in all the building trades both local and national; and for uniform policies in handling apprentice training of returned veterans under the educational and financial aid provisions of the "G. I. Bill". An executive committee was named to effectuate policies of the construction industry and to act in the interim between meetings of the general committee.

Members of the General Committee on Apprenticeship for the Construction Industry, in addition to Chairman Marion H. Hedges, attending the meeting were: William J. Barney, Chairman, Apprenticeship Committee, Associated General Contractors of America; E. L. Flentje, Executive Secretary, National Association of

Master Plumbers; Oscar A. Reum, President, Contracting Plasterers' International Association; G. S. Stuart, Executive Director, Painting and Decorating Contractors of America; Joseph C. Fitts, Secretary, Heating, Piping and Air Conditioning Contractors, National Association; John E. Rooney, General President, Operative Plasterers' and Cement Finishers International Association; and Maurice A. Hutcheson, First General Vice-President, United Brotherhood of Carpenters and Joiners of America.

IES RESEARCH FUND TRUSTEES ELECT OFFICERS

At the first meeting of the Board of Trustees of the IES Research Fund held recently, the following officers were elected for the coming year's activities:

Chairman, P. H. Daggett, dean of the College of Engineering, Rutgers University, New Brunswick, N. J.; treasurer, A. H. Nicoll, president of Graybar Electric Company, New York; and secretary, A. Dexter Hinckley.

The other members of the Board are: Dr. Conrad Berens, ophthalmologist, president of the Medical Society of the County of New York; Laurence A. Hawkins, executive engineer of the Research Laboratories of the General Electric Company, Schenectady, N. Y.; A. W. Deller, patent counsel for the International Nickel Company; Howard M. Sharp, president IES, 1943-44, manager of residence and Farm Bureau, Buffalo, Niagara Electric Company and S. B. Williams, president IES 1944-45, editor of *Electrical World*.

The Board also discussed a number of research projects which had been developed by the Research Coordinating Committee in recent years. The appointment of a Research Executive Committee of six was also discussed. Such a committee when appointed, will have the responsibility of preparing research projects for the Trustee's consideration, and following through the work of such projects to their final completion and publication.

OPA REGIONAL OFFICES TO ACT ON APPLICATIONS

Regional offices of the Office of Price Administration have been given authority to act on applications from sellers of services requesting simplification of the method of determining their ceiling prices.

This action makes no other changes in the existing provision that sellers of a variety of services who price under six specified regulations may make application for permission to determine ceilings for all services under only one regulation.

The decentralization move, effective December 30, 1944, permits Regional Administrators, in turn, to delegate the same authority to OPA district offices, through which it is intended applications should be filed in the future. The move should facilitate action on these applications.

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Now . . . with war orders being slowly reduced . . . we are able to turn our attention to the regular Faries Line.

Being faced with no reconversion problem, production has already been resumed on some important items . . . notably incandescent and fluorescent industrial brackets. Others will follow quickly upon the release of limitation orders.

It is with great pleasure that we again greet our many friends in the trade.

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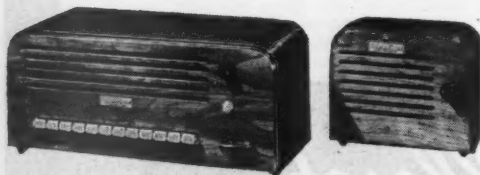
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... Everything the most discriminating eye for beauty could desire in modern styling. Everything advanced electronic engineering skill and ingenuity are capable of producing in inter-communication that continuously meets the most rigid requirements of convenient, efficient, care-free, economical operation in large organizations or small . . . a unit for every need . . . within the price range of every prospect.

Everything in prestige, sales co-operation and jobber protection essential to establishment of profitable and permanent trade.

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Talk-A-Phone's many outstanding features . . . talking points that batter down sales resistance . . . and you'll admit that the World's Most complete Line of Inter-communication "HAS EVERYTHING". Good deliveries. Address Department A-2.



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Since October 18, 1943, suppliers of services whose ceilings are established by more than one of six specified regulations could apply to OPA's national office for authority to determine their ceilings by using only one of the regulations. The aim has been to simplify price control for services coming under six different regulations, some or all of which might be regularly offered by one supplier.

The six regulations are: General Maximum Price Regulation; Maximum Price Regulation 134 (Construction and Road Maintenance Equipment Rental Prices and Charges for Operating and Maintenance or Repair and Rebuilding Services); Maximum Price Regulation 136 (Machines and Parts and Machinery Services); Revised Maximum Price Regulation 165 (Services); Maximum Price Regulation 246 (Manufacturers' and Wholesale Prices for Farm Equipment), and Revised Maximum Price Regulation 251 (Construction Services and Sales of Installed Building Materials).

There are two limitations to this authority: (1) No authorization may be granted to apply the provisions of Revised Maximum Price Regulation 251 to services subject to any of the other five regulations. (2) In the case of suppliers subject to Maximum Price Regulation 134 or Maximum Price Regulation 136, the authority may be granted only by OPA's national office if the supplier's sales of services under either of these two regulations exceeded \$75,000 for the calendar year 1942 or for the fiscal year ending in 1942.

NHA APPOINTS ARCHITECTURAL ADVISORY COMMITTEE

An Architectural Advisory Committee has been formed to guide and assist the Federal Public Housing Authority, local housing authorities, and any others inter-



C. C. HUNTER of Elmira, New York and consulting engineer to Remington-Rand. To meet the maintenance requirements of the vast fluorescent installation at the Propeller Division plant in Birmingham, he designed a mono-rail system to carry an under-slung buggy which now speeds cleaning and tube-replacement.

rested in the design and development of low-cost housing for the future.

The committee has been initially organized under the chairmanship of Howard Myers, publisher of Architectural Forum, with William W. Wurster, dean of the School of Architecture at the Massachusetts Institute of Technology, as vice-chairman. Membership will consist of representatives of the architectural and engineering professions and of local housing authorities.

The committee will undertake independent studies of the design and development of low-rent projects under the Federal Public Housing Authority and its predecessor, the United States Housing Authority, and evaluate this experience on the basis of ideas and designs that should be incorporated or expanded in future low-cost housing and of mistakes to be avoided or experiments which should be abandoned or modified.

The committee will be given full access to the records of the FPHA and of local authorities and a program of specific studies will be drafted as soon as its organization is complete.

The committee plans to employ the expert talents of its members in their particular fields of design, construction, and family requirements, and to harmonize technical requirements with the living needs and habits of families for whom low-cost housing is intended.

REGULATION REQUIRES COMPLIANCE WITH WMC ORDER

A priorities regulation dealing specifically with compliance with WMC regulations has been issued by the War Production Board, following a statement on manpower ceilings issued at the White House by Director of War Mobilization and Reconversion James Byrnes:

(a) Priorities and allocations may be withdrawn or modified if WMC regulations are not complied with: Any priorities or allocations granted by or under the authority of the WPB may be withdrawn or modified at any time when the WPB makes a finding that materials or facilities are not being used most effectively for the prosecution of the war as a result of a failure to comply with an employment ceiling or hiring regulation of the War Manpower Commission.

(b) Procedure: Priorities or allocations will be withdrawn or modified under this regulation only after the WMC has certified to the WPB that an employer has refused to comply with an employment ceiling or hiring regulation within a reasonable time after he has been notified of his failure to do so. If, in the opinion of the WPB, there is reason to believe that materials or facilities are not being used most effectively for the prosecution of the war as a result of the failure to comply, it will institute proceedings before one of its Compliance Commissioners to determine whether there is proof of this, and will give the employer appropriate notice and opportunity for a hearing.

(c) What priorities and allocations are

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FOR HOMES

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FOR COMMERCIAL BUILDINGS

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...IT'S Naturally BETTER!

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Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volt; powered by water-cooled, 2-cylinder engine.



Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or three-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types available. Write for engineering assistance or detailed literature.

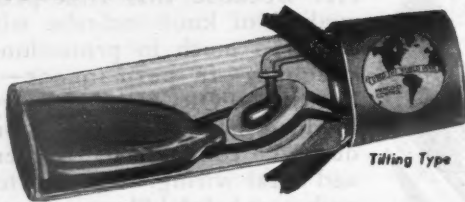
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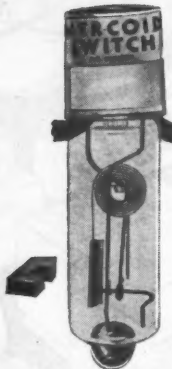
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*Assure Accuracy, Positive
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Tilting Type



Magnetic Type

Mercoid hermetically sealed mercury switches are the most dependable means for opening and closing an electrical circuit. They cannot be affected by dust, dirt, moisture or corrosion; nor are they subject to open arcing, pitting, oxidation or sticking of contacts.

Mercoid Switches are successfully used in many industrial applications.

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covered by this regulation: This regulation applies to all kinds of priorities and allocations which are granted either before or after this regulation is issued, including preference ratings, allotment numbers or symbols, and directions, authorizations, or grants of appeals to deliver or receive material or to manufacture products or to use facilities.

FPHA PLANS DISPOSITION OF WAR HOUSING

The Federal Public Housing Authority will enter 1945 with 95% of its war housing construction task completed, but it still is faced with a number of vitally important building jobs and the biggest civilian housing management assignment in history, reports Philip M. Klutznick, FPHA Commissioner.

The FPHA has had the responsibility for the bulk of the publicly financed war housing program totaling 830,000 accommodations. Of these, 768,000 had been completed by October 31. The total program involves 583,000 family dwellings, 166,000 dormitory units and 81,000 stop-gap accommodations.

"While the FPHA must concentrate on meeting war needs, we have moved up on the 'problems ahead,' Commissioner Klutznick said. "As a result of preparations made in 1944, the FPHA will be ready during the coming year to undertake disposition of war housing wherever it becomes surplus because of progress on the battlefronts. And as a result of studies being completed by communities over the country, we also expect to have firm estimates of postwar needs and of the programs those communities will want to undertake in the low-rent housing field when the necessary Federal aid becomes available."

The war housing job has neared completion in the face of mounting shortages of both materials and manpower. Savings in manpower, materials, money and time have been accomplished through the use of temporary construction, portable shelters and the conversion of existing buildings to provide additional accommodations.

Looking toward the liquidation of the government's war housing investment when war production is curtailed and workers return to peacetime jobs, the FPHA established a disposition branch in 1944 and began developing procedures and techniques for accomplishing the task.

"Disposition of the stock of permanent housing is primarily a matter of obtaining a fair return to the government and avoiding disruption of local housing.

Temporary housing, built with substitute materials and emergency construction methods, is not suitable for long-term residential use. To explore the possibilities of reducing disposition costs and of conserving in more usable form the materials from this temporary housing, experiments were conducted by FPHA in dismantling the structures in panels. These panels can be reassembled into utility buildings suitable for a variety of non-residential purposes or packaged for con-



C. H. CRAWFORD, plant engineer of the Remington-Rand, Propeller Division plant in Binghamton, New York, who can now back up his arguments with facts from experience data in favor of bus-duct network with respect to flexibility, capacity and insurance against outage.

venient shipment to new sites in this country or abroad.

In preparation for meeting postwar housing needs, the FPHA has suggested that local communities get firm estimates of their needs in the low-rent field which cannot be served by private enterprise and to indicate, in applications for a postwar shelf of both urban and rural projects, a proposed three-year program if federal funds are made available.

During the war 63,000 war dwellings are being completed with low-rent housing funds and will become low-rent housing after their war need is served.

In looking toward the postwar expansion of the low-rent housing program, the FPHA commissioner reiterated the proper sphere of public housing in the postwar era:

(1) No new public housing should be provided where it is possible to fill a need with decent existing housing.

(2) No public housing should be provided that will compete with private capital in its appropriate sphere.

(3) To induce private capital to provide standard housing for the lowest possible income market, a gap of some reasonable percentage, say 15 to 20 percent, should be left between the highest income to be served by public housing and lowest income which can be reached by new private housing.

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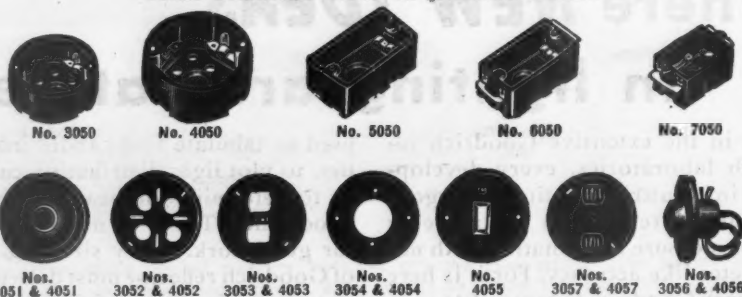
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These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

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had a preliminary course last year), the Electrical League of Indianapolis, Inc., is sponsoring a course of five evening sessions beginning Monday Jan. 8th at Ipalco Hall (Indianapolis Power & Light Co., Indianapolis. A nominal registration fee of \$2.00 for members and \$3.00 for non-members covers the cost.

Designed for men who want practical non-technical information to use in their daily work, the course will be of particular benefit to industrial electrical men, contractors and merchandisers of electronic devices. Based on preferences indicated on a recent survey of the membership, the sessions will cover the following subject matter: Initial session—A Resume of the Fundamentals of Electronics presented by Prof. C. W. Caldwell of Purdue University; successive classes will be devoted to discussions and demonstrations of Motor Speed Regulation, Welding Timers, Rectifiers, and High Frequency Heating. Experts from these specialized fields have been secured to handle these subjects. Round table discussions are slated to follow the formal presentation of each subject.

ELECTRICAL INSTRUMENT PRODUCTION UP 4000 PERCENT

Electrical instrument production for war requirements of the United States has spiraled to 28,000,000 instrument units yearly—4,000 per cent above pre-war (1940) output—it is reported in a review of the electrical instrument industry's contributions to victory.

This is a "war of instruments," it was stressed in the report, with 1,000 required



WALTER J. RIDER, owner of a motor shop by the same name in Binghamton, New York, has his shop filled with equipment of his own design to do a better qualitative and quantitative job for his customers.

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for a battleship, 150 for a submarine and 10 for a tank. A thousand-plane raid may entail simultaneous employment of 500,000 instruments—and these raids now are a commonplace.

The 1940 production of instruments totaled 700,000 units. In 1941, foreign war and other orders jumped the figure to 1,400,000. In 1942, the government's war needs came to 60,000 airplanes, 45,000 tanks, 20,000 anti-aircraft guns, 8,000,000 tons of merchant vessels, five battleships, 800 destroyers and convey craft. To meet these huge demands, the industry produced 14,000,000 instrument units.

In 1943, requirements were virtually doubled, and they were met, the report stated. The 1944 production was maintained at approximately the same level, and the 1945 schedule is unchanged.

Radar and radio output—the war's most dramatic developments, perhaps—has increased 40 percent, with a comparable spiraling of instrument needs.

Simplification of pre-war specialized instruments has cut in half the types and variations utilized. Prior to the war, approximately 100,000 variations existed.

Many companies, the report pointed out, have eliminated usual commercial barriers—so that facilities of one major company will be used to produce designs of another company.

HOWARD L. MILLER AGAIN HEADS ELECTRICAL ASSOCIATION

Howard L. Miller was re-elected president of The Electrical Association of Philadelphia for 1945 at the annual meeting of the Board of Governors held on December 12th. At the same time the other officers were likewise retained to serve next year.

Mr. Miller is president of Utilities Engineering Company and is widely known in the electrical construction business.

The other officers are: H. B. Bryans, executive vice-president, Philadelphia Electric Company, vice president; Philip H. Ward, Jr., president, Ward Electric Company, treasurer; and Robert J. Moran, Chief of Electrical Department, Middle Department Rating Association, secretary.

SUPPLEMENTAL FORM FOR HOUSING CONSTRUCTION IN CONGESTED WAR AREAS

A supplemental Form WPB-2896.2, to be used in conjunction with the present application Form WPB-2896 for housing to be constructed in accordance with the H-2 program for congested war areas, was announced jointly by the War Production Board and the National Housing Agency.

Instructions on the supplement Form WPB-2896.2 modify instructions on Form WPB-2896 to the extent that certain

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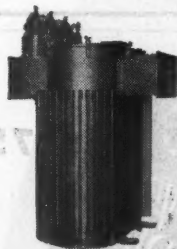
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have shown us the most frequent points of failure, thus enabling us to take exceptional precautions to eliminate failures at such points.

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M1 (Synchronous)	1	50 A. at 125 V.	14 Ga. Steel
M2	2	50 A. at 125/250 V.	14 Ga. Steel
RM	1	50 A. at 125 V.	Cast Iron
RMS	2	50 A. at 125/250 V.	Cast Iron

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EUGENE G. GRACE, who became president of Bethlehem Steel at thirty-seven, says about observation;
WALTER A. GIFFORD, who became president of A. T. & T. at forty, says about listening to opinions;
CHARLES E. WILSON, self-made president of General Electric, says about wanting to get ahead;
WALTER D. FULLER, who advanced from selling copies of the *Saturday Evening Post* to presidency of the Curtis Publishing Co., says about Big Ideas to get ahead;
LOUIS RUTHENBURG, who became president of Servel at forty-six, says about the spirit of work.

The observations of these and many other important men of industry lend concrete evidence to back up the soundness of Dr. Laird's book. The book gives seasoned, practical advice on the technique of handling people and shows in quickly understandable fashion how to use the psychology of leadership.



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This readable, practical manual presents 11 pointers on what to do and say in your everyday contacts with others, in order to win their friendship, good-will, and cooperation. The methods are clearly demonstrated in numerous stories of real people, outstanding leaders, of today, and together form a direct, easy-to-understand, easy-to-use technique for improving your relations with others and especially for securing better results in training, directing, supervising, and other elements of successful leadership.

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paragraphs and sections of the latter form are not required to be filled out.

Form WPB-2896.2 requires the applicant to describe certain features of the proposed house by checking a simple outline specification in order to arrive at a determination that the rental or sales price is properly related to the accommodations to be constructed. In addition, the applicant furnishes one copy of the floor plan and one copy of the front elevation, showing general floor layout, overall dimensions and approximate room sizes. Such determination by the Federal Housing Administration, of the National Housing Agency, is for priority purposes only and has no bearing upon any determination in connection with a concurrent application for mortgage insurance on the property involved, the agencies said.

Under the H-2 program the National Housing Agency is permitted to approve shelter rental up to \$65 a month and sale prices not to exceed \$8,000 where NHA determines such prices are required in order to provide an acceptable three-bedroom house. In many areas, the maximum sales and rental limits will be lower, as determined by NHA.

Occupancy of housing built under the H-2 program is not limited to in-migrant war workers, but has been extended to anyone in need of such accommodations in congested war areas, WPB and NHA pointed out.

Certification formerly required on Form WPB-2896 with regard to occupancy, rental and sales limitations has been revised in the supplemental Form WPB-2896.2 in accordance with the policy change for H-2 housing.

Copies of Form WPB-2896.2 to be used in conjunction with WPB-2896 for all H-2 housing will be available at all Federal Housing Administration field offices, WPB and NHA said.

NHA MAKES YEAR-END REPORT

Urgent new demands resulting from the stepped-up production of arms and ammunition means that all housing activities still must be concentrated on shelter for essential war workers in the months ahead and that other types of residential construction must wait, National Housing Administrator John B. Blandford, Jr., has declared.

More than 50,000 war housing units must be built, in addition to those already under construction, to meet needs resulting directly from the expanded demands from the battlefronts, with the result that any large programs to alleviate general congestion in war-crowded communities may be delayed for some time.

"Nevertheless, the pattern was laid during the last months of 1944 for the building of homes approximating pre-war standards," Mr. Blandford said. "And as a result of the present availability of various building materials and equipment which could not be spared for housing in the last two years, any permanent con-



ELECTRICAL CONSTRUCTION of the Middletown Air Depot, Middletown, Pennsylvania, was speeded under the able supervision of John F. Behny, assistant engineer in charge of electrical design and inspection, and Robert W. Johns, field superintendent of construction for Howard P. Foley Company, Inc.

struction which can be permitted now will be better than that of a year ago.

"Until the sudden upsurge in demands for shelter for new workers to be recruited for key war plants, we had hoped for a considerable volume early in 1945 of housing designed to relieve general congestion and built without occupancy restrictions, and also for a large volume of housing to relieve hardship cases and particularly to take care of returning veterans.

"These two programs—known as H-2 and H-3 housing—will be carried on to the extent that supplies of material and manpower permit, with special regard for housing for returning veterans who cannot find suitable accommodations for themselves and their families, but nothing can be permitted to interfere with the basic H-1 program, which is housing for migrating war workers needed to bring production to the desired peak and keep it there."

The war housing program can be said to be nearing completion and needs of war workers have been met in most parts of the country. However, the new demands are of an extremely critical nature and of an importance out of all relation to their size. Most of the construction now being scheduled is of a temporary nature, and much of it will be located in scattered and isolated communities.

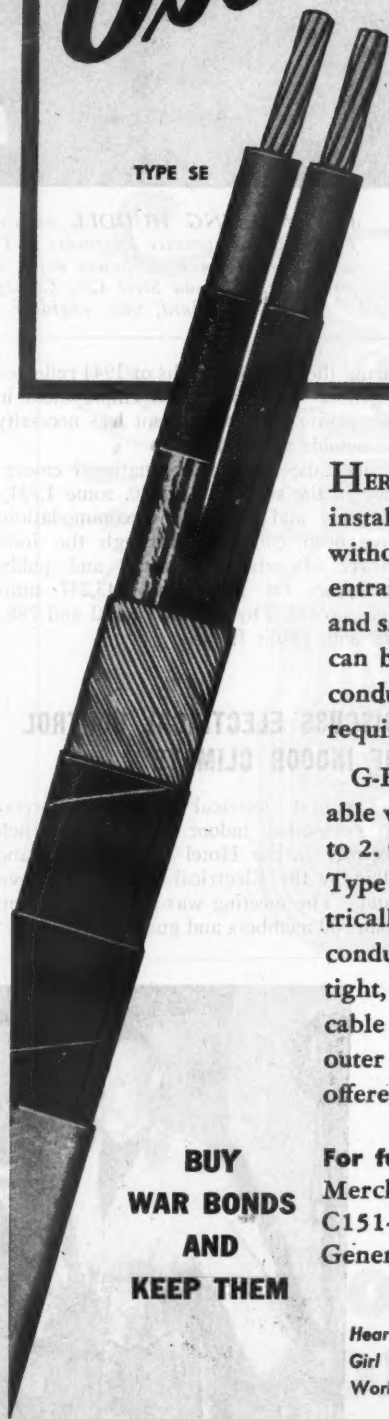
A total of 277,657 accommodations for war workers and their families were completed in 1944 up to Oct. 31 and an additional 81,812 were under construction on that date. Of those completed, 131,694 were financed by private capital, most of the units being single family dwellings. The other 145,963 units were provided with public funds, 76,977 of them being family dwellings, 19,906 dormitory-type for single workers and 20,760 stop-gap units, principally trailers; and 28,320 converted units.

In 1943, a total of 504,024 units were completed. The smaller number finished

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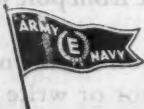


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POST-MEETING HUDDLE on control problems at recent session of the Electrical Maintenance Engineers of Chicago, finds (L to R) N. R. Kirkdoffer, ass't. general foreman, power dept., and R. J. Beeswy, ass't. supt., electric and power dept. Inland Steel Co., Chicago, listening intently to solutions offered by Frank Burd, sales engineer of Cutler-Hammer, Inc., Milwaukee.

during the first 10 months of 1944 reflected a general levelling off of employment in war plants with consequent less necessity for outside recruitment.

Since the start of the national emergency in the summer of 1940, some 1,731,422 new and converted accommodations have been completed through the joint efforts of private industry and public agencies. Of this total, 943,247 units were provided by private capital and 788,175 with public funds.

DISCUSS ELECTRICAL CONTROL OF INDOOR CLIMATE

The first electrical industry conference on controlled indoor climate was held recently in the Hotel Statler, Cleveland, Ohio by the Electrical League of Cleveland. The meeting was attended by more than 300 members and guests.

"Enthusiasm in the Cleveland group is another evidence of the considerable interest the electrical industry throughout America has in the great postwar possibilities of controlled indoor climate," said P. B. Zimmerman, President, Indoor Climate Institute, who was one of the speakers on the program.

The first real interest shown by electrical men in the promotion of better heating, cooling and air conditioning came at Indoor Climate Institute's Open Forum held in Detroit last September. The Ninth Annual Conference, International Association of Electrical Leagues, was meeting in Detroit at the same time and T. A. Crawford, First Vice President of Indoor Climate Institute was invited to address this convention. Many of the electrical men also heard Merrill E. Skinner, Vice President, Buffalo, Niagara and Eastern Corporation, when he spoke before the I.C.I. Forum on the "Utilities' Program to Promote Greater Indoor Comfort and



ELECTRIC MOTOR SERVICE COMPANY gang of Jamestown, New York. Left to right are: Harold H. Carlson; Bert Hanson, owner; and Fred A. Johnson. All three are ingenious inventors and have equipped their shop with all kinds of special tools and machinery to do special jobs and as labor-saving devices. The photo-flash seems to have caught Fred napping.

Health". Following these talks a number of utilities and electrical men attended the seminar on Local Chapters which was a part of the I.C.I. two-day conference and which was chairmaned by Jack Searls of White Rodgers Electric Company.

In October the Electrical League of Cleveland appointed an Indoor Climate Committee to develop a promotional program. The first step of this committee was to sponsor the Cleveland meeting.

George Boeddener, Managing Director, National Warm Air Heating and Air Conditioning Association was the first speaker on the program. His talk dealt with a program for training installation men, contractors and dealers. He said, "Action must supplement planning right now, if this industry is to get its share of the consumers' dollar."

Mr. Boeddener was followed by C. T. Burg, General Sales Manager, Iron Fire-



JOHN P. MARX, *United Electric Company, Elmira, New York, who uses a degreaser unit for softening insulation varnisher before stripping. In this way he avoids the danger of cracking and warping motor frames and distorting the core iron which sometimes happens when burning out by flame.*

man Manufacturing Company and member of the I.C.I. Board of Directors. Mr. Burg discussed the sales techniques needed to sell controlled indoor climate. "Today, more than ever before, the air conditioning industry must think in terms of aggressive selling," Mr. Burg stated.

C. E. Lewis, President, Oil Heat Institute of America and member of the Advisory Council to the Board of I.C.I., was the third speaker on the afternoon program. In his talk on the oil heat industry's plan for promoting controlled indoor climate Mr. Lewis said, "Action gets results; this makes sense—and profits! Study your market, know your product, map your campaign; then follow through."

W. R. Moore, Regional Manager, Minneapolis-Honeywell Regulator Company, was the last speaker before dinner. He pointed out that the turnover in heating dealers is 38 percent. "This," he reasoned, "shows a definite need for training." In outlining the market opportuni-

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FLUR-O-LOCKS keep lamps securely in place, reduce accidents, tend to increased efficiency of lamp, starter and ballast

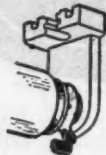
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Protect your customers and their machinery from the danger of falling fluorescent lamps due to vibration or insecure installation and avoid possible law suits by equipping fluorescent fixtures with this simple yet effective locking device.

FLUR-O-LOCKS tend to increased efficiency of lamp, starter, and ballast—lock lamp securely in place, are economical and easy to install.

FLUR-O-LOCKS are warehoused and sold by General Electric, Westinghouse, Graybar Electric, Supply Houses, and other distributors and are at present standard equipment in more than 5,000 leading industrials.

Write for samples and descriptive folders



FLUR-O-LOCKS are economical and as easy to install as illustrated in the diagram.



Illustration of two fiber parts of FLUR-O-LOCKS—perforated disc and key—as applied to fixture and adjusted for locking.

Flur-o-Locks by
LADUBY COMPANY
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ties for controlled indoor climate in the Cleveland area Mr. Moore explained that of the 220,000 homes 205,000 had central heating systems but that only 40,000 of them had automatic firing installations. He estimated the immediate postwar market for automatic control equipment in the Cleveland area at \$650,000. He said that approximately \$300,000 of this total would go into existing homes, \$200,000 into new homes and \$150,000 into commercial installations. In summing up his remarks Mr. Moore said, "Let's be realists; we are all interested in profits. Your share will depend upon you and your merchandising methods."

P. B. Zimmerman, President, Indoor Climate Institute and Vice President and General Sales Manager, Chrysler Corporation, Airtemp Division, was the after dinner speaker at the Electrical League of Cleveland's conference. His subject was "Making Cooperation Count." He showed how basic industries develop through progressive cycles of an introductory period, an acceptance era and finally the demand period. Mr. Zimmerman traced the growth of several industries; electric refrigeration, radio, automobile and household appliances. He emphasized that the demand period must be preceded not only by product development which always increases utility and economy, but by an educational program that will enable the public to evaluate the benefits to be derived from the product.

Zimmerman said, "Tomorrow we will reap the benefits of today's cooperative effort, tomorrow this effort must be redoubled."

Jack North, President of the Electrical League of Cleveland and General Sales Manager, Cleveland Electric Illuminating Company, presided over the industry conference.

HIBBEN LECTURES SAFETY GROUP ON BETTER LIGHTING

Expanded uses of new and better illuminants in the home, factory and down on the farm will help minimize the high rate of accidents caused by inadequate and improper lighting.

Speaking to the safety officials from 15 states gathered in the Hotel Henry Grady, Atlanta, Georgia for the final session of the two-day meeting, Samuel G. Hibben, director of applied lighting for the Westinghouse Lamp Division, Bloomfield, N. J., said:

"Every home in America could be well lighted if the cost of home accidents during the past year, more than one-half billion dollars, were to be spent for improved lighting. After the war we will be able to light our way to safety with new types of illumination as never before."

Describing phosphor-treated furniture as self luminous, the lighting specialist predicted that shin-skinning while groping for the light switch in a darkened living room will be obsolete. Even the switch itself, treated with a phosphorescent coating, will be visible in the dark.

Phosphors and fluorescent coatings have already passed military tests with flying colors, he pointed out. Luminescent in-

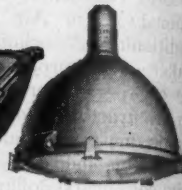
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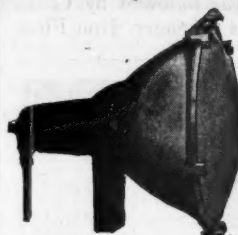
Better Design — Easier To Wire



750 to 1500
watt enclosed
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High Bay Units for
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75 to 1000 watt enclosed
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hazardous pole
climbing.

The Revere Line is complete, covering units for Airport, Marine, Industrial and sports use. Write for Catalog supplements.

REVERE ELECTRIC MFG. CO.
2025 NORTH PAULINA STREET, CHICAGO 13
Originators of the Hinged Floodlight Pole
INDOOR and OUTDOOR LIGHTING EQUIPMENT of EVERY DESCRIPTION

Safe-T-Glow

HIGH TENSION DETECTOR



Model A
3-ft.
handle

Model B
6-ft.
added
extension

SAFETY RULES call for that EXTRA precaution and additional RECHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages... prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

TEST-O-LITE

Tests Everything Electrical
from 100 to 550 Volts



Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List Price \$1.50 at leading jobbers.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.



GEORGE F. BRESSLER, electrical superintendent of plant No. 2, Harrisburg Steel Company, Harrisburg, Pennsylvania, who has expanded his electrical shop to handle his own motor repair work.

strument panels now permit crews of surface and underwater craft to navigate in the dark even though their normal electric power facilities may be knocked out by enemy action. Instrument dials of aircraft are treated with fluorescent coating so that the pilot's vision, sharpest when it is dark adapted, is unimpaired. "Phosphorescent and fluorescent printing on the instrument dials will take this extra step for safety."

Demonstrating some of the new tools in the hands of lighting engineers, Mr. Hibben displayed a shock-proof lamp which was developed for use in shipyards, where welding sparks are apt to shatter ordinary lamps.

Mr. Hibben, who assisted civilian committees during preparations for blackouts and dimouts, said these wartime necessities have made Americans more conscious than ever of the dangers and discomforts of darkness. He predicted that there will be a sharp reaction in the form of demands for a much greater use of good lighting after Germany surrenders.

NEW SYMBOLS STANDARD APPROVED BY ASA

The American Standards Association has announced approval of a revised "American Standard for Graphical Symbols for Telephone, Telegraph, and Radio Use," giving new symbols for new types of apparatus and reconciling conflicts in previous standards. The spur that war needs have given to the development of radio and communications equipment places upon the standard a particular importance for engineers, designers, and draftsman in the power and communicating fields.

It is a revision of, and supersedes the

THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM...

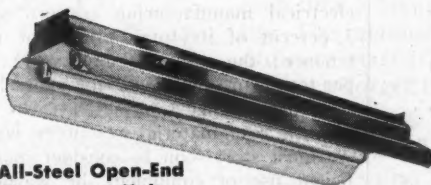


Light lifts the Shadow from Plant Morale!

Better lighting of the Wheeler type... *Skilled Lighting*... means higher morale through reduced eyestrain and fatigue. When you raise morale with *Skilled Lighting*... backed by Wheeler's advanced engineering... you automatically get better production too!

Wheeler reflectors for fluorescent and incandescent installations are the product of 64 years of specialized light engineering. They are *engineered* to produce maximum illumination from standard lamps. They are *built* for long service and easy maintenance: high-grade, heavy duty materials throughout... heavy vitreous enameling that really stands up and retains its high reflection factor.

Learn how you can brighten morale and boost production - get acquainted with Wheeler's complete line of Reflectors. Write for Catalogs. Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. Also New York. Representatives in principal cities.



**All-Steel Open-End
Fluorescent Unit**

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuous runs.



RLM Solid Neck Incandescent Reflector
Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

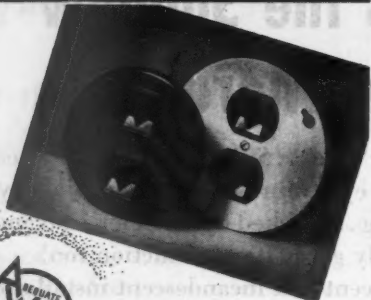
Distributed Exclusively Through Electrical Wholesalers

Wheeler *Skilled Lighting* REFLECTORS

Made by Specialists in Lighting Equipment Since 1881

STAR ATTRactions

FOR PLANNING
NEW HOMES...



Insist on P&S

Available in T-slot or parallel slot types—Specification or "Competitive"—Single or duplex—Single for Combination Wiring—Brown or ivory—With Bakelite or metal covers. Every one a P & S Quality Product.

Send for Catalog for complete listing.

Sold Thru Electrical Wholesalers

PASS & SEYMOUR, Inc.
SYRACUSE 9, N. Y.

American Standard Symbols for Telephone, Telegraph, and Radio Use (Z32.5) published in 1942, but it includes solutions for conflicting symbols in the power and communications fields that were worked out in the war standard published earlier this year (Z32.11), and it incorporates new material.

HAYNES HEADS CONSTRUCTION BUREAU

John L. Haynes, formerly chief of the Building Materials Division, W.P.B., has been named head of the new Construction Bureau. The Construction Bureau includes the Building Materials Division, the Construction Machinery Division, the Plumbing and Heating Division and the Facilities Bureau. Mr. Haynes succeeds Arthur J. McComb.

CHICAGO E.M.E. LEARN ABOUT MAINTENANCE ADVANCES

At a recent dinner meeting at Phil Smidt's Restaurant, Roby, Indiana, more than 200 members of the Electrical Maintenance Engineers of Chicago, heard H. R. Meyer, manager, maintenance department, Westinghouse Electric & Manufacturing Company, review the general maintenance situation throughout the country with particular emphasis on new developments and operations designed to prolong life of electrical equipment and reduce maintenance costs.

Defining maintenance as "that operation which, through inspection, repair, etc., assures maximum life and productive capacity of equipment" Mr. Meyer added that maintenance is a big business, cost of which is chargeable directly against operations. Illustrating his point, he revealed that railroads in 1936 spent 30.5 percent of their entire revenue for maintenance of ways, structures, equipment, etc. (\$1,237,000,000); in 1943, 28 percent of revenue (\$2,546,000,000) with the cost increasing in 1944. Returning to the industrial field, he revealed that one electrical manufacturing concern spends 3 percent of its total billing for maintenance; the mining industry 15 cents per ton of ore produced; the paper industry, 10 cents per ton.

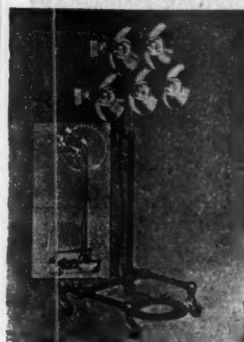
With raw material resources waning, we must start soon to consider more efficient use of equipment, he warned as he outlined some of the recent developments in maintenance materials that saved the day during the present wartime period. Outstanding among these is glass insulation which permits greater capacity in smaller space and will stand up to 500 degrees C. before breaking down. A new inorganic silicon-resin varnish to withstand high temperatures (organic varnish breaks down at 150 degrees C.) is now developed, he revealed. Large scale commercial application, however, depends upon the use of high-temperature ovens in which to bake coils impregnated with this new varnish. Phos-copper brazing is another new development permitting elec-

A SPECIAL MESSAGE About Infra-Red Ray Drying

To Those Whose Production Requirements Necessitate the Use of Lacquers, Synthetics, Paints and other Finishes



Use Nalco Infra-red Ray Drying Equipment to solve a wide variety of problems . . . spot drying and baking of various finishes and dopes . . . quick drying of varnishes and impregnating materials for motor windings and electrical and mechanical parts of all types.



NALCO DRITHERM LAMPS

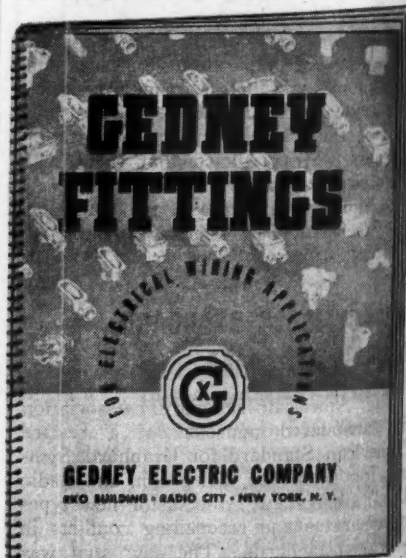
- Will Cut drying costs and time.
- Eliminate "warm up" time.
- Require no enclosures nor ovens.
- Use a minimum of space.

Left — Nalco 5-light portable adjustable unit.

**NORTH AMERICAN
Electric Lamp Co.**
1044 Tyler St. St. Louis 6, Missouri

SEND FOR THIS
HELPFUL DATA

GEDNEY FITTINGS



GEDNEY ELECTRIC COMPANY
850 BUILDING - RADIO CITY - NEW YORK, N. Y.

"Gedney Fittings Fit"

SOLD THROUGH WHOLESALERS
GEDNEY ELECTRIC COMPANY
RKO BUILDING NEW YORK 20, N. Y.

trical connections and joints to have the same conductivity as the copper surrounding them and withstand temperatures up to 1300 degrees C., which bids well to eliminate numerous maintenance headaches, he added.

Metal-spraying, a life saver for repairing motors where no spare parts were available; high altitude carbon brushes for d.c. motors; cotton belting which has no slippage; and other wartime maintenance developments were outlined as the manufacturer's contribution toward overcoming material shortages and prolonging the life of existing equipment—all items which will find extensive use in our peacetime economy once the shooting stops.

MINNESOTA INSPECTORS TO JOIN N.C.E.I.

A more thorough coordination of electrical industry groups in the state of Minnesota has been accomplished with the recent decision of the Minnesota Electrical Inspectors Association to join North Central Electrical Industries—the all-industry electrical group with headquarters in Minneapolis. The decision was based upon the recommendations of a special inspector's committee composed of members Rowell, Hackett and Glasow, appointed by president Martin to investigate the advisability of affiliating with N.C.E.I.

Being a member of the N.C.E.I. family with representation on the Board of Directors will give the inspectors an opportunity to voice their views on important industry problems—particularly rural wiring and safety—which affect the future growth of the electrical industry in the Minnesota area.

CHICAGO GROUPS ELECT '45 SLATE

Two electrical groups in the city of Chicago recently held their annual election sessions to choose officers for the coming year. Tabulation of ballots revealed the following results.

Cook County Electrical Contractors Association—president, incumbent T. L. Hankins, Condo Electric Co.; vice-president, incumbent Emil Dehaan, Service Electric Shop; secretary, Joseph Turek, Avers Electric Co., Berwyn; treasurer, incumbent Joseph Kunst, Principle Electric Company. Directors are Henry Bell, Commodore Electric Co.; Roy Clausen, West Town Electric Co., Cicero; P. J. Falson, Falson Electric Co.; J. D. Hawkes, Jr., A B C Electrical Contracting Co.; incumbent J. M. Naal, Naal Electric Co.; Leo W. Witz, Continental Electrical Construction Co., and incumbent Howard Zingraf, Square Z Electric Company. The Board of Directors is composed of the officers, directors and immediate past president, Ed Wigdahl, Wigdahl Electric Company.

Simplify

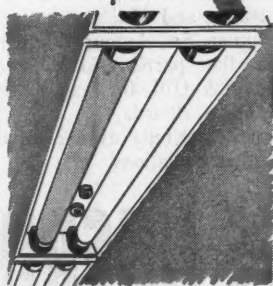
LIGHTING MAINTENANCE

with G-E

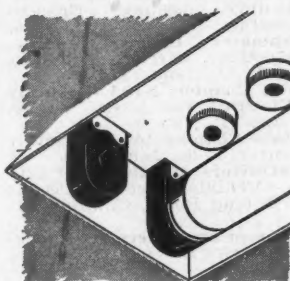
Watch Dog

REG. U.S. PAT. OFF.

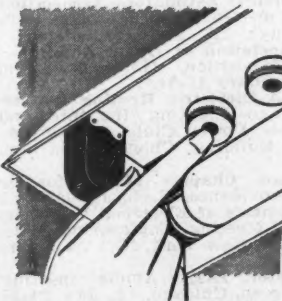
STARTERS



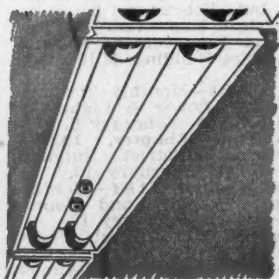
When the lamp dies the Watch Dog cuts itself out stopping annoying blink and flicker.



Manual reset button pops up eliminating futile and needless starting attempts.



When dead lamp is removed the Watch Dog is easily reset by pushing in the button.



New lamp is inserted in lamp-holder and it immediately begins to operate normally.



You can simplify fluorescent lighting maintenance to the easy job of pushing a reset button before relamping. G-E Watch Dogs eliminate the necessity of replacing a starter each time a lamp reaches the end of its useful life. This manual reset starter can outlast five ordinary starters. To relamp merely reset it and then forget it.

We can furnish you with the complete story on how to use fluorescent accessories for best lighting results. Send your request to Section G-152-8, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Connecticut.

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs; "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

GENERAL ELECTRIC

New

THIS 56 PAGE INFORMATIVE BOOKLET

To those interested in insulating varnish, this booklet presents an informative and worthwhile approach to their insulation problems. A valuable, ready reference!



- ★ Product Information
- ★ Reference Tables
- ★ Illustrations
- ★ Research
- ★ Testing Procedure
- ★ Application Methods
- ★ Solvent Chart

SEND FOR YOUR FREE COPY TO-DAY

Just pin the coupon to your Company letterhead and return it to us.

Firm _____
Name _____
Address _____
City _____ State _____



JOHN C. DOLPH COMPANY

Insulating Varnish Specialists

168-A Emmet St., Newark, New Jersey

The Chicago Electric Motor Service Association, Central District Chapter, NISA, chose the following officers to guide the association through 1945: President, Paul Martin, Northwestern Electric Co.; vice-president, Harold Weygant, Hygrade Electric Co.; secretary, Robert Kaska, Chicago Electric Co.; treasurer, incumbent J. J. Smat, Queen City Electric Company. Members of the Board of Directors include Charles Kaska, Chicago Electric Co.; Roy T. Hyre, Hyre Electric Co.; P. J. Maher, Excel Electric Service Co.; Paul Sievert, Sievert Electric Co.; incumbents E. J. Ther, Ther Electric and Machinery Co., and Arthur Wagner, Sr., Arthur Wagner Company. Immediate past-president Bert Hohman, Hohman & Hill, Inc., continues as a member of this Board.

Herbert Binner continues as executive secretary of both associations.

DATES AHEAD

Utah Chapter IAEI—Monthly meeting, Auditorium of Utah Power and Light Co., Salt Lake City, Utah, January 2.
Chicago Section, Illuminating Engineering Society—Monthly meeting, Chicago Lighting Institute, Chicago, Ill., Jan. 5.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., January 8.
Central District Chapter, NISA—Monthly meeting, Electric Association Dining Room, Chicago, Ill., Jan. 9.
Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., January 9.
Electrical Contractors Association of City of Chicago—Monthly meeting, Electric Association Dining Room, Chicago, Ill., Jan. 10.

Louisiana Engineering Society—Annual meeting, St. Charles Hotel, New Orleans, La., January 11-13.

Kentucky Chapter IAEI—Louisville, Ky., January 11 and 12.

Cook County Electrical Contractor's Association—Monthly meeting, Electric Association Dining Room, Chicago, Ill., Jan. 15.

Chicago Electrical Estimators Association—Monthly meeting, Chicago Engineers Club, Chicago, Ill., Jan. 15.

National Association of Home Builders—Postwar Exposition, Hotel Sherman, Chicago, January 15-20.

Induction and Dielectric Heating Conference—Chicago Lighting Institute and Great Lakes Power Club—Auditorium, Marquette Building, Chicago, Ill., Jan. 16-18.

Roger William Chapter IAEI—Monthly meeting, Providence, R. I., January 17.
American Institute of Electrical Engineers—Technical Meeting, Engineering Societies Building, New York, N. Y., January 22-26.

Illinois Chapter, IAEI—Annual meeting, Hotel Sherman, Chicago, Ill., Jan. 24-25.

National Industrial Service Association, Inc.—Joint conference of New York Metropolitan Chapter and New England Chapter, Hotel Lexington, New York City, January 26.

Indiana Chapter IAEI—Antlers Hotel, Indianapolis, Ind., February 1-2.

Industrial Electrical Exposition—Electrical Maintenance Engineers of Milwaukee, Public Service Building, Milwaukee, Wis., Feb. 1-3.

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, February 6.

George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., February 12.

Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Bldg., Denver, Colo., February 13.

Wisconsin Chapter, IAEI—Raulf Hotel, Oshkosh, Wis., Feb. 15-16.

Wisconsin Electrical Association—Annual conference, Loraine Hotel, Madison, Wis., February 17-18.

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, March 6.

Midwest Power Conference—Palmer House, Chicago, Ill., April 9-10.

DOUBLE OPPORTUNITIES for SALES AND PROFIT SELLING AND INSTALLING



**AUTOMATIC
POULTRY
TIME
SWITCHES
for
LIGHTING
POULTRY
HOUSES**

Cash in on this profitable market! Every poultry raiser now knows that **LIGHTS INCREASE PRODUCTION AND PROFIT**. They all want these Poultry Time Switches. Sell them! Install them! The season's short. **ACT NOW!**

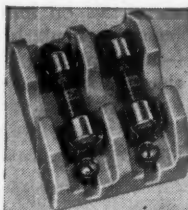
**FOUR MODELS
\$12.00 to \$18.00**

With and without "Dimmer Circuit"
All-Electric and Manually-wound

Write for Information

**AUTOMATIC ELECTRIC MFG. CO.
MANKATO, MINNESOTA**

Better Fusing Efficiency



Old bulky cartridge type fuses.

New Littelfuses 3 A G and 3 A B. Saving 1 1/2 cu. in., in this example.

with
**SPACE
SAVING**



3 A G Glass-enclosed Littelfuse 1 1/4" long, 3/4" dia. (Slo-Blo construction shown.)

Glass-enclosed 3 A G, to and including 6 amp., 250 V. Use with electric appliances, heavy duty power supplies, amplifiers, radios, motors, etc. (Slo-Blo type also made for 1/100 amp. for electric fences, etc., and 1/32 amp., for control circuits, small coils, etc.)



3 A B Fibre-enclosed Littelfuse 1 1/4" long, 3/4" dia.

3 A B fibre-enclosed fuses, 8 to 20 amp., 250 volts. Greater precision, and space-saving in still heavier duties.



Glass-enclosed 3 A G Littelfuse 1" long, 3/4" dia.

INSTRUMENT LITTELFUSES

From 1/200 to 15 amp., 250 volts AC or DC. For voltmeters, milliammeters, galvanometers, thermocouples, etc.

LITTELFUSE INCORPORATED
4757 Ravenswood Ave. Chicago 40, Ill. 200-0000 St. El. Main 1-10

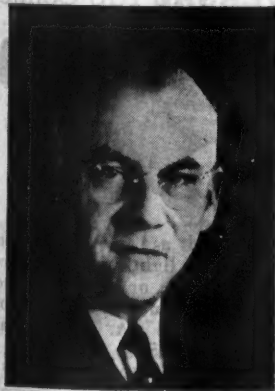
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., March 12.
 Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Bldg., Denver, Colo., March 13.
 Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, April 3.
 George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., April 9.
 Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., April 10.
 National Industrial Service Association—Annual conference, LaSalle Hotel, Chicago, April 16-18.
 National Electrical Manufacturers Assn.—Spring Conference, Palmer House, Chicago, Ill., April 16-19.
 International Lighting Exposition—Palmer House, Chicago, Ill., April 19-23.
 National Electrical Wholesalers Assn.—Spring meetings, April 23-25.
 Electrical Committee, N.F.P.A.—Edge-water Beach Hotel, Chicago, Ill., Week of May 14.
 American Institute of Electrical Engineers—Summer Technical Meeting, Hotel Statler, Detroit, Mich., June 25-29.
 National Electrical Contractors Association—Annual conference, Grand Hotel Mackinac Island, Mich., Sept. 9-15.

MANUFACTURERS NEWS

G-E APPOINTMENTS

R. H. Luebke, assistant manager of the Appliance and Merchandise Department in charge of legal matters and previously assistant general counsel of the General Electric Company, has been elected a vice president and general counsel of the company, succeeding the late Darius E. Peck.

Announcement has been made of the retirement of Joseph E. Kewley, as vice president and general manager of the Lamp Department at Nela Park, Cleve-



M. L. SLOAN

land, and the election of M. L. Sloan as vice president to succeed him. In his capacity as vice president, Mr. Sloan will become general manager of the department.

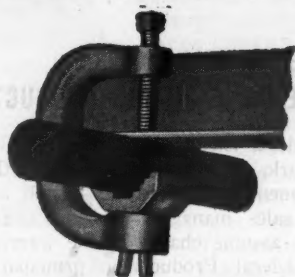
L. R. Boulware, former operations vice chairman of the War Production Board, has been appointed to the staff of Charles E. Wilson, president of the General Electric Company, as a consultant on marketing and merchandising.

N. R. Birge, a vice president of the

LATROBE PRODUCTS

FLOOR
BOXES

WIRING
SPECIALTIES



No. 470 "BULL DOG"
PIPE or CONDUIT HANGER

Convenient for hanging 1/2" 3/4" and 1" pipe or conduit to steel beams up to 3/8" thick.



No. 252R TWO GANG BOX

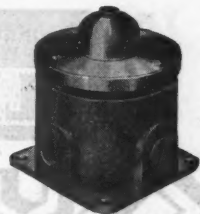
Two gang adjustable Floor Box. No. 208 Receptacle in one section: One cover plate has 1/2 in. flush brass plug and one has 2" flush brass plug.



No. 330 "LATROBE"
TOM THUMB
UTILITY OUTLET

Ideal for use in wood installations and other moisture-free locations.

Latrobe Products sell readily. But of even greater importance, they stay sold. Three reasons, Dependable quality, Ease of installation, lasting service.



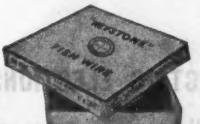
No. 150 BOX
No. 207 NOZZLE

Fine for installation in concrete or wood finished concrete floors.



"BULL DOG"
B X STAPLES

Any quantity—packed in cartons, kegs and barrels.



KEYSTONE
FISH WIRE

Tempered just right—Ten sizes. —many lengths.



"BULL DOG" INSULATOR
SUPPORTS

Convenient little clamps of high tensile strength for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

FULLMAN
MANUFACTURING CO.
LATROBE, PA.

QUALITY

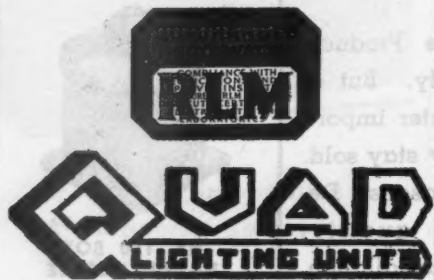
ALWAYS



RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods



RLM Threaded Dome Reflector



● QUAD Units have proved themselves in long-time service. Contractors enthusiastically endorse them because they live up to their claims—they give good lighting efficiency for long periods and require very little attention. Install QUADS for industrial or commercial installations—indoor or outdoor. Good business is the result. QUAD . . . for today and for tomorrow.

Manufacturers of Incandescent Lighting Equipment

QUADRANGLE MFG. COMPANY

32 S. PEORIA ST.

CHICAGO 7 ILLINOIS

company who for many years has been responsible for the operations of G-E affiliated companies, retired on December 31.

The appointment of J. F. McBride as sales manager of the range division has been announced.

The Board of Directors of G-E have created a new department in the organization, to be known as the Chemical Department and Dr. Zay Jeffries, technical director of the company's Lamp Department, has been elected a vice president in charge. The new Department will assume responsibility for the operations pertaining to the Resin and Insulating Materials Division and the Plastics Division of the Appliance and Merchandise Department.

C. E. SCHOLL JOINS FEDERAL ELECTRIC PRODUCTS

Federal Electric Products Co., Inc., of Newark, N. J., has announced the appointment of Charles E. Scholl as general sales manager. He will direct all sales, assume charge of the warehousing of Federal Products in principal cities



C. E. SCHOLL

and play an active part in coordinating the advertising and sales promotion programs scheduled for postwar markets.

Mr. Scholl, identified with the electrical industry for more than 20 years, was sales manager of Bright Light Reflector Co. of Brooklyn, which position he resigned to join Federal.

RELiance ELECTRIC ELECTIONS

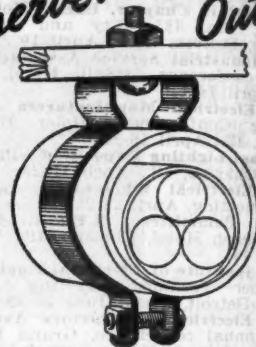
Clarence L. Collens, for 37 years president of the Reliance Electric & Engineering Company, Cleveland, has been elected to the newly-created post of chairman of the board, and is succeeded in the presidency by James W. Corey, sales vice president since 1940.

Announcement was made of the resignation, to become effective January 1, of H. M. Hitchcock, senior vice president and treasurer. Mr. Hitchcock has postponed his resignation for several years in the interest of expanded war-time operations. He will, however, remain a director of Reliance.

MINERALLAC

Steel HANGERS, CLIPS, STRAPS

Outserve! Outlast!



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

Steel Straps for Messenger-cable services on outlet boxes; may be used in conjunction with hangers.

Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street Chicago 7, Illinois

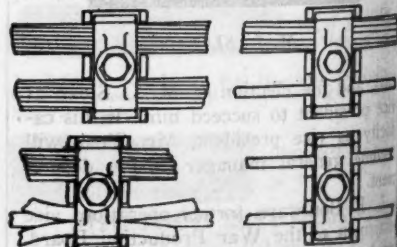


UNIVERSAL Tap Connector



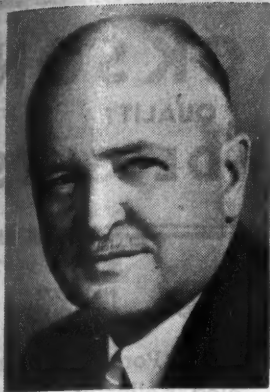
Effectively used as guy line ground, or transformer and lightning arrester connection to A. C. S. R. or copperweld conductors where the diameters may be from 3/4" copperweld to .595" A. C. S. R. armor rods. Wire sizes .595" to 5/32".

ADAPTABLE TO A WIDE RANGE OF USES



WRITE FOR BULLETIN 8-B

KRUEGER & HUDEPOHL
732-B VINE ST. * CINCINNATI 2, OHIO



JAMES W. COREY

A. M. MacCutcheon, engineering vice president, was elected to fill the office of senior vice president upon Mr. Hitchcock's retirement.

C. V. Putnam retires after 38 years with the company, to be succeeded in the office of secretary by Roscoe H. Smith, who will continue his duties as head of the sales promotion department.

Edward E. Helm, since 1928 district sales manager in Philadelphia, has been appointed general sales manager. Kenneth S. Lord will succeed Mr. Helm as manager of the Philadelphia district.

ANACONDA CHANGES

J. W. Mullally has resigned as Chief of the Wire and Cable Branch of the Copper Division of WPB, effective November 15th. He will continue as a consultant for a limited period. Mr. Mullally has resumed his work as manager of Bare and Weatherproof sales of the Anaconda Wire and Cable Company with headquarters in New York.

Announcement has been made of the appointment of J. L. Tindale as special representative of Rural Line Extensions. Mr. Tindale until his release with an honorary discharge was a Lieutenant (j.g.) in the United States Navy.

FEDERAL ELECTRIC CHANGES

Ray Becker, recently in charge of Federal Electric advertising sales in the Chicago district, has been named sales manager of the Federal Brilliant Company of St. Louis.

Orville F. Allen, with Federal Electric Company for the past 20 years and until recently head of the Personnel and Traffic Department at Chicago, has been appointed Federal branch manager at Cincinnati.

At Indianapolis, Earl J. Michaels, takes charge as branch manager after 26 years with Federal. He leaves the Credit and Adjustment Departments at Chicago to assume his new duties.

F. E. Cody, for 19 years with Federal, leaves his post as branch manager at Indianapolis, to assume charge of the Federal Electric branch at Milwaukee, Wis.

IT'S TIME TO INVESTIGATE TIMERS

WHEN PLANNING your future stocks or installation work, get full information about Paragon Automatic Time Controls... because they offer possibilities for handsome profits. These instruments are used in plants of all types and are built into numerous kinds of equipment. They save time... multiply human output... reduce errors... increase efficiency... and lower costs. Because they have been extensively used and are widely advertised, Paragon controls offer you the opportunity of large future sales.

HUNDREDS OF APPLICATIONS—Some of the numerous applications of timers are: Protecting component parts, such as electronic tubes... Automatically turning air conditioning units on and off... Sequence Timing... Laboratory Testing... Conveyor Control... Light Exposure... Heat Treating... Pump Operation... Machinery Operation... Plastic Molding... Time delay on pump back spin... Controlling pre-heating schedules.

CALL THE PARAGON REPRESENTATIVE... for assistance in selection and correct application of Paragon controls.

PARAGON ELECTRIC COMPANY

710 Old Colony Building • Chicago 5, Illinois

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905



**"Here's a fitting
made for
MY convenience!"**



**"At any time, I can take out
one fitting and put in an-
other — without disturbing
the conduit."**

**"If necessary, I can put in a
new line of conduit before the
fittings are delivered."**

**"I can do these things because
every Kondu box is a union."**



**At ANY outlet of ANY
Kondu fitting, you can use
ANY kind of conduit—mak-
ing either a threaded or
threadless connection.**

**Just insert the right bushing
for what you want to do. Bush-
ings are interchangeable—and
low in cost. (This helps to
keep down your fittings inven-
tory.)**

**100% re-usable . . . Kondu
fittings are malleable iron,
practically unbreakable . . .
They give you a conduit line
that's permanently tight, rigid,
vibration-proof.**

Write for the Kondu catalog.

**KONDU CORPORATION
Erie, Pa.**

Kondu Mfg. Co. Ltd., Preston, Ontario

KONDU



**The Threadless Fitting Line
of Unequalled Variety**



WESTINGHOUSE APPOINTMENTS

Harry B. Higgins, president of the Pittsburgh Plate Glass Company, has been elected to the Board of Directors of the Westinghouse Electric and Manufacturing Co.

R. H. St. John has been appointed manager of the Albany branch of the Westinghouse Electric Supply Company. Mr. St. John replaces Alger Reilly, who has been transferred to the Newark branch of the Company.

U.S. RUBBER CHANGES

James E. Power has been appointed eastern sales manager of the mechanical goods division, United States Rubber Company.

H. S. McPherson of St. Louis has been appointed midwestern sales manager of the mechanical goods division and W. M. Ballew of Kansas City, Mo., has been shifted to the post of southwestern sales manager.

John Blake has been appointed manager of marine cable sales, with headquarters in New York City.

GRAYBAR APPOINTMENTS

E. R. Yonkers of Kansas City, Mo., has been appointed to the position of manager of Graybar Electric Company in Omaha, replacing T. W. Conrad, who has retired on a service pension.

J. E. House was appointed Graybar Manager in San Antonio, replacing J. E. Lowrey, who will retire on a service pension early this year.

American Steel & Wire Co., U. S. Steel subsidiary, has named Willis T. Cramer as assistant director of research, succeeding Raleigh H. Barnes, deceased. Mr. Cramer was promoted to his new position from the company's Cuyahoga Works.

Harold Martin has been appointed assistant manager of New England sales by the American Steel & Wire Co. Mr. Martin will continue to be located in the Boston sales office where he has been manager of merchant product sales since March, 1942.

The M. B. Austin Company of Chicago has named Harry J. Kahn as general sales manager. He succeeds Arnold Friend, who is retiring from active participation in sales work but will continue as treasurer and as a director. Mr. Kahn has been with Thomas & Betts for the last 15 years, seven of which he spent in Cleveland as district manager and the last seven in Chicago as Midwest District manager.

JACKSON QUALITY YARDLIGHTS



**No. 8972—12" Porcelain Enam-
eled Reflector.**

**No. 8974—14" Porcelain Enam-
eled Reflector.**

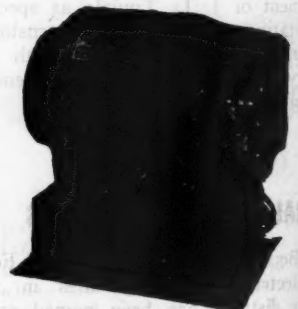
**Wired complete—
for REA installations.**

- Available at your Electrical Whole-
saler
- Ready for immediate shipment
- Manufacturers of Industrial Light-
ing Equipment

**JACKSON
ELECTRICAL COMPANY
900 W. VAN BUREN ST.
CHICAGO 7, ILL.**

110-Volts A. C. from Direct Current

with **KATOLIGHT ROTARY KON-
VERTERS** Change 32, 110 or 220 volts
D.C. to standard 110-volt, 60-cycle A.C.
for operating radios, electronic & sound
apparatus, electric signs, A.C. appli-
ances, etc.



KATO ROTARY KONVERTER, 225 Watts

**Pioneers in the Building of
Small Rotary Converters**

**At present Kato's entire production
must be directed to furnishing convert-
ers on priority orders.**

**Also manufacturers of A.C. and D.C.
generators ranging from 350 watts
through 25 K.W.; power plants; Fre-
quency Changers; and Motor Gener-
ator Sets.**

**KATO ENGINEERING CO.
639 N. Front St., Mankato, Minnesota**

American Central Manufacturing Corporation, Connerville, Ind., has announced the appointment of J. W. Derr as district manager for the Southwestern division. Mr. Derr was a field representative for the San Diego division of Consolidated Vultee Aircraft Corporation prior to his joining American Central. He will make his sales headquarters in Dallas, Texas.

The Trumbull Electric Mfg. Co. of Plainville, Conn., announces that George L. Stout, who recently was appointed representative in the Cleveland District, was made manager of that district as of October 1. C. F. Latham, former manager, has been transferred to the New York District office.

Littelfuse Incorporated of Chicago has opened an Eastern office at 70 Pine Street, New York. Jack D. Hughes has been appointed Eastern Division Sales Manager. Mr. Hughes has been production manager of the Chicago Littelfuse plant. He will now handle eastern sales from the New York office.

Federal Telephone and Radio Corporation of Newark, has announced the appointment of Frank O. Zimmerman of Oak Park, Ill., as assistant manager of the Chicago sales branch. Mr. Zimmerman formerly was with Westinghouse Electric Elevator Company at Chicago and Indianapolis.

Allen-Bradley Company of Milwaukee, Wis., announces the appointment of E. B. Dewey as sales representative in Kalamazoo, Mich. He will cover Southwestern and Central Michigan.

The National Supply Company, Pittsburgh, announces the election of E. H. Thorsteinson as vice president and controller. He joined the company as controller in 1942, coming from Montgomery, Ward & Company.

Copperweld Steel Company, Glassport, Pa., announces the return of Captain Clyde C. Sowards after a two and one-half-year leave of absence to serve in the U. S. Army. He will make his headquarters in the New York office and will cover the northern portion of the South Atlantic States.



CHAMPION

Behind the **CHAMPION DIAMOND**
is more than just another

Fluorescent or Incandescent Lamp

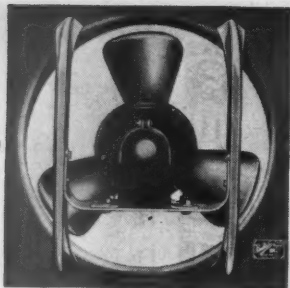
First, there's one of the best equipped plant and production organizations in the industry, backed by 45 years of specialization in fine lamp manufacture.

Then, there's expert lighting engineering service readily available to you through the Champion force of trained men in the field.

Finally, there's Champion economy resulting from a most efficient industrial distribution service which combines with Champion quality lamps to provide lowest cost, lamp for lamp, performance considered.

CHAMPION LAMP WORKS
Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



Easy . . . to sell to install to service

Dealers — **RIGHT NOW** is the time to get lined up for post-war sale of Buffalo Fans! Your customers know that "Buffalo" fans have an established reputation for high quality. They also know that "Buffalo" ratings are certified. That makes Buffalo Fans easy to sell.

The heavy-duty, industrial-type construction of Buffalo fans with flanged edge, square panel construction makes installation easy.

Buffalo wheels have heavy-gauge, die-stamped blades, heavy-duty hub; and each wheel is carefully balanced before assembly.

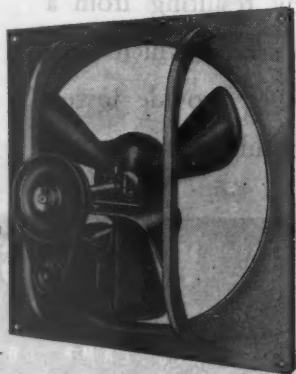
Only first grade motors are supplied with Buffalo fans—so service costs are practically nothing.

If you want to sell Buffalo Fans, write today for data Bulletin 3222 and prices.



BUFFALO FORGE COMPANY
143 Mortimer St., Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd.
Kitchener, Ont.

"Buffalo" FANS



Annual Wage

[FROM PAGE 53]

Joint Recommendations

In October, 1943, the Labor-Management Planning Committee on Post-war Problems of the National Electrical Contractors Association and the International Brotherhood of Electrical Workers recommended the adoption of the annual wage.

"There appears to be an inevitable drift toward placing the industry on an annual basis for workers. This has been a concept in the industry for a quarter of a century. It arises naturally in the industrial maintenance field. The union has never opposed the introduction of the annual income method of paying workers and no doubt will accept any plan that would appear to be stable and offer a full year's employment.

"It is a recommendation of the Planning Committee that the industry consider this form of payment anew and the planning Committee believes that an opportunity offers itself for sound experimentation on a local basis. Well-established contractors could well enter into agreements with local unions guaranteeing full-time employment on an annual income basis. Of course this implies a certain amount of reserve funds so that the local union can be guaranteed payment on this basis. If the plan is successful on a local basis, it appears to the Planning Committee that it would be easy to pass to the annual income form of payment on a national scale as the industry progresses to closer organization and to more mobility."

Since October the two associations have been struggling to implement this program, and certain practical difficulties have arrived. Some of the obstacles which must be overcome are psychological. If the United States could pass over-night from one type of economy to another, there would be no psychological obstacles on the employer's part; but transition will be slower; there will be a good deal of confusion over a period of a number of months, and the employer is often afraid that he is going to be caught between two economies—one dead and the other powerless to be born. So the employer is timid about granting what might be a maximum adjusted yearly income. The contractors propose some formula like this: "It is recommended that the minimum compensation for each class of workmen on annual employment

INCREASING YOUR HOLD ON YOUR JOB



and giving yourself
a chance for advancement

Few men deliberately plan to work persistently on self-improvement. If progress comes naturally, they are happy; if it does not, they either worry or they entirely ignore the situation.

Yet it is possible to pay attention to self-improvement with considerable hope of success. A noticeable degree of advancement is practically assured to anyone who will make an intelligent and persistent effort.

Thousands of men have proved this for themselves, with the use of

The CROFT Library of Practical Electricity

7 Volumes, 2906 pages
1948 how-to-do-it illustrations

● The Croft Library is a complete electrical educator. Founded on practice—on 20 years of shirt-sleeve experience—on work as it is actually done. Jammed from cover to cover with the kind of hardheaded facts you want. Written so that the beginner can easily understand it, yet so sound, so thorough, that it is the daily guide of 59,000 highly paid electrical workers and engineers.

● Croft tells you the things you need to know about motors, generators, armatures, commutators, transformers, circuits, switchboards, distribution systems—electrical machinery of every type—illumination in its every phase—the most improved methods of lighting—lamps and lamp effects, etc.—how to do a complete job, from planning it, to completion.

**NO MONEY DOWN
EASY PAYMENTS**

10 DAYS' FREE EXAMINATION

Fill in and mail the coupon below and we will send you the entire set of seven volumes for ten days examination on approval. We will take all the risk—you assume no obligation. If you decide to keep the books, send \$3.00 in ten days and the balance at the rate of \$3.00 a month.

Send this McGRAW-HILL coupon

McGRAW-HILL BOOK CO.
330 W. 42nd St., New York 18, N. Y.

You may send me the seven volumes of the Croft Library of Practical Electricity for 10 days' examination. I agree to return the books, postpaid, in ten days or remit \$3.00 then and \$3.00 a month until the special price of \$18.00 has been paid.
(To insure prompt shipment, write plainly and fill in all lines.)

Name
Home Address
City and State
Position
Name of Company
.....

Electrical Contracting, January 1945

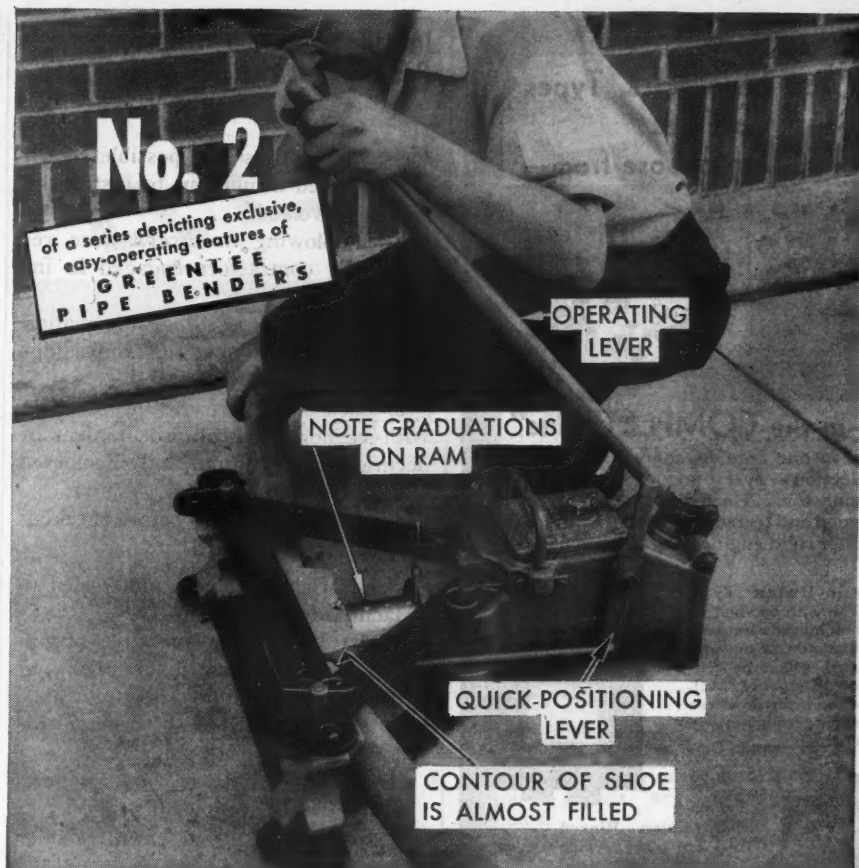
should be a weekly salary equal to 70 percent of the established hourly rate for intermittent employment, multiplied by 40." In cities where a \$2.00 hourly wage schedule is now in effect, this would produce only about \$2912 a year, on a 52-week basis.

Workers also face psychological obstacles. Men long inured to the turbulence of the construction industry, where intermittent employment has been the rule, appear to prefer to take their chance on 200 days of employment at the higher hourly wage than to pass to the more stable annual income basis. The electrical construction industry has sought to meet these obstacles by securing the adoption of what might be called a permissive provision in contracts between local unions and electrical contractors.

The United States has long been known as a center of engineering and mechanical skills. Miracle production during the war has been the result of a great project in cooperation between labor and management and Government and it certainly has been a testimony to the genius of the American people. Whether the American people can repress individualism to that extent that cooperation shall rule between groups so that a peacetime economy will produce a national income not unlike what we have produced under the stress of war, remains to be seen. The annual wage will then be an end-product of American engineering genius.



H. R. MEYER, manager, maintenance department, Westinghouse Electric & Mfg. Co., drives home an emphatic point in his talk on advances in electrical maintenance techniques before the Electrical Maintenance Engineers of Chicago.



Makes precision bends, every time

ONE MAN can get precise, smooth bends in a few minutes with a GREENLEE Hydraulic Bender. Whether bending pipe up to 4½", rigid and thin-wall conduit, tubing or bus bars, it is simple, fast and easy this way.

As illustrated, pumping of operating lever exerts powerful hydraulic pressure. Bend is complete when shoe is almost filled. Graduations on ram permit operator to identify precise length of ram travel—a sure guide in making *exact*, duplicate bends every time.

Whatever your bending job, use a GREENLEE to do it better, faster. One man operated... easily carried to the job and set up. GREENLEE Benders eliminate manufactured bends and fittings... save time and material on the job.

Get complete facts on Hydraulic and Hand Benders and other GREENLEE time-saving tools for electrical workers. Write today for free catalog 33 E. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1741 Columbia Avenue, Rockford, Illinois.



OTHER GREENLEE TIME-SAVING TOOLS FOR ELECTRICAL WORK:

- CABLE PULLERS
- JOIST BORERS
- HAND BENDERS
- RADIO CHASSIS PUNCHES
- PIPE PUSHERS



Get Ready with Greenlee!

GREENLEE

FOR THE CRAFTSMAN

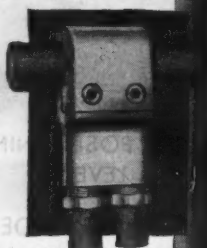
**"You have ALL Types
of Tees
to choose from—**



—in the COMPLETE line"

All in one catalog, for your handy selection—every good type of tee connector... Each one carefully designed and tested, and manufactured under rigid engineering supervision.

Penn-Union Type HFM, with one-bolt or 2-bolt hinged clamp for the main. One or more branches can be connected afterward. Multi-slit tapered sleeve assures permanent grip on branch.



Penn-Union Hinged E-Z Tee takes a wide range of branch sizes. One-piece design makes installation easy. Tap connections can be made at any time.



Clamp Type Tees for all sizes of tubing and cable—a complete line. Machined contact surfaces.

Types for All Combinations—for connecting flat bar, run or tap, to tubing or cable. Also "general utility" tees that take a wide range of conductor sizes.



Penn-Union E-Z Tee is ideal for accommodating a large range of conductor sizes on both the main and branch. Will not loosen. 2, 3 or 4-post.

Penn-Union fittings are preferred by utilities, industrials, electrical manufacturers, contractors—because they have found that **Penn-Union on a fitting is their best guarantee of dependability.**

**PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.** Sold by Leading Jobbers

PENN-UNION
Conductor Fittings

Installation Only Projects

[FROM PAGE 61]

such work because the possible return is considered insufficient to justify the gamble involved.

The following *handicaps* were reported by contractors engaged in installation-only work:

1. Difficulty in getting information for plans and on material and equipment.

2. Lack of authority to deal directly with vendors delayed procurement of accurate information and hampered coordination of deliveries.

3. Materials ordered before checking by contractor resulted in:

(a) Cables not cut and reeled to facilitate installation.

(b) Unbalanced quantities of materials and accessories; and/or not conforming with job requirements.

(c) Conduit fittings ordered for locations requiring pull boxes.

(d) Pipe fittings and supports not standard equipment.

(e) Pull boxes too small; and/or openings and K.O.'s wrong size and location.

(f) Fixtures (lighting) not adapted to job; or with wrong conduit entrances.

(g) Equipment normally pre-assembled, delivered knocked down.

(h) Motor terminal heads inadequate.

4. Material orders held up because of incomplete listings (fittings, hangers, bolts, pull boxes, bushings, elbows, frames, switches, splicing materials, aligners, etc.)

5. Improper timing of material and equipment deliveries.

6. Jobber substitution of unsuitable material for that ordered.

7. Excess labor costs for—protecting, cleaning and shifting material and equipment delivered long before actually needed; for handling and cleaning material and equipment brought in from other plants; for lost time due to delays and disruptions caused by above procurement failures.

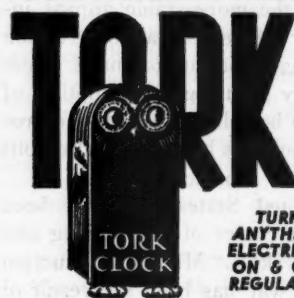
8. Excess tool costs—for correcting equipment; fabricating normally prefabricated equipment; tools tied up on the job longer than necessary.

9. Lack of cooperation of owner's representatives due to misunderstanding the contractor's problems.

10. Plans supposed to be furnished by owner were:—not available when needed; incomplete; not construction plans; not coordinated; lacking information on building construction and

WHERE To BUY

**Equipment, Materials and
Supplies for Electrical
Construction — Maintenance — Repairs**



**The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK**

DRILL CONCRETE THE EASY WAY

**WODACK "DO-ALL"
ELECTRIC HAMMER AND DRILL**

Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1 1/2" dia., metal 3/4". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for bulletin.

**Wodack Electric Tool Corporation
4628 W. Huron St. Chicago 44, Ill.
Telephone AUstin 9866**

SWITCHPLATE LAMP

An Ideal Over Door Signal . . .
A real lamp in a switchplate. Mounts on a single-gang box. Ideal for scores of applications where a modest light is adequate. Low current consumption. Perfect for "over door" signal; to mark equipment; for elevator up-down signals; etc. Use either 3 or 6 watt 56-120 volt tungsten lamp. 2" lens diameter. Colors, red-green-white.

Sold Nationally by
THE GRAYBAR ELECTRIC CO.
Mfr'd by the H. R. Kirkland Co., Morristown, N. J.

for
**SAFETY'S SAKE
SODER-FLUX**
Underwriters' Approved
L. B. ALLEN CO., INC.
6715 Bryn Mawr Ave. Chicago 31, Ill.

Electric Heating Elements Now You Can Repair Them USE NICHROCITE PASTE

Simply overlap ends, apply Nichrocite Paste and turn on current. Used by large utility companies. Trial order, \$1.00; 4 oz., \$2.50; 1 pound, \$8.00.
Advance Co. Box E.C. 861, Minneapolis, Minn.

lay-out of other equipment; deceptive as to the amount and nature of the work.

It is difficult to anticipate such hazards and estimate the total effect on the cost of the work. Engineering and administrative costs are increased. On top of actual labor increase, there is the cost of delays and disruptions. Usually, there is nothing to indicate just how much trouble will be encountered.

The accompanying chart gives some idea of how such costs add up. *Just how much should be allowed in an estimate rests with the individual estimator and the particular job.* In too many cases such costs have been regarded lightly, and contractors have suffered accordingly.

Considering the costs in Chart I, one might regard it poor economy for an owner to buy his own materials. In most instances that would be true—if he had to pay the right price for the installation. However, *as long as some contractors continue marking-up material sufficiently to cover part of the labor burden, and are willing to donate their tools and engineering services to the owner who will buy the mechanics' labor, the owners will save by furnishing their own materials.* If the buyer is sympathetic to reason and the contractor is smart, there is a good chance that a labor and material contract will be let.

When a contractor is asked to submit an installation-only price, he should suggest that the owner also consider a price for the complete job. It must be understood, however, that the contractor is to have a right to go over his propositions with the owner. The accompanying comparative estimates together with Chart I on "Installation-Only Projects", should serve as a good guide for selling complete jobs.

In cases where it would be wasted time to even try to sell the material, the contractor should estimate the costs of the job so that there will be a return commensurable to the services rendered along with furnishing labor.

It would be too much to hope for any rapid decrease in the tendency of owners to buy their own material, but some individual contractors have been very successful in stemming this practice. It is a hard pull to convince a customer, who has made up his mind to buy his materials, that he will gain in the long run by letting a contractor supply both material and labor.

One thing should always be remembered—*there is no such a thing as a "labor-only" job in the electrical contracting business.*

NEWS

**FOR MANUFACTURERS
WHO WANT BETTER CIRCUIT
PROTECTION AT LOWER COST**

Quicklag COLUMN-TYPE

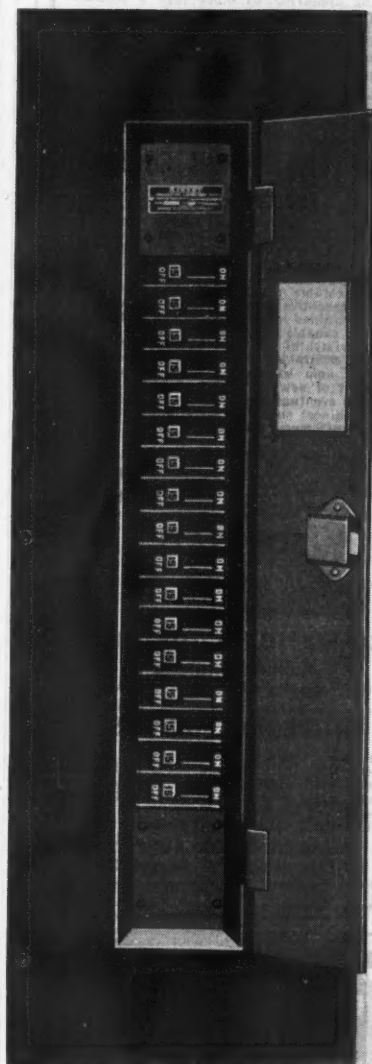
**Circuit Breaker Panels Reduce
Current Interruptions and Conserve
Vital Floor Space**

When you install Kinney "Quicklag" Column-Type Circuit Breaker Panelboards in your small tool and lighting circuits, you get these two important benefits:

1. Greater freedom from work stoppages due to current interruptions,
2. Greater conservation of floor space because panels are mounted in H-beams.

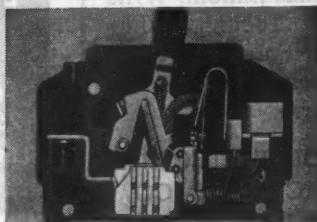
Here is how these low cost panelboards save you money by reducing production delays and work stoppages due to current interruptions. The amazing thermal-magnetic breaker elements in Kinney "Quicklag" panelboards actually resist tripping on harmless, momentary overloads, yet trip faster and more positively on dead shorts and dangerously prolonged overloads.

Designed to mount in standard H-beam columns of industrial buildings, Kinney "Quicklag" Column-Type Circuit Breaker Panelboards are not only far more accessible, but conserve vitally needed floor space as well. It will pay you many times over in savings of time and money to set Kinney "Quicklag" Column-Type Panelboards high on your list of reconversion plant projects.



COMPARE THESE FEATURES OF KINNEY "QUICKLAG" PANELS BEFORE YOU BUY

- Lowest cost circuit breaker protection
- Full time delay on harmless overloads
- Faster tripping on dead shorts
- Deionizing principle arc quench
- Breaker handles are trip free
- Breakers enclosed in shock proof Bakelite cases
- Single or double-pole breakers supplied as required
- Listed by Underwriters' Laboratories



This interior view of a "Quicklag" breaker shows the sturdy construction and thermal-magnetic principle.

PANELBOARDS
SWITCHBOARDS

KINNEY ELECTRICAL MFG. COMPANY • 2900 CARROLL AVENUE • CHICAGO 12, ILLINOIS

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : "OPPORTUNITIES" : EQUIPMENT
BUSINESS : " : USED OR RESALE

UNDISPLAYED

RATES

DISPLAYED

(Not available for equipment advertising)
10 CENTS A WORD. MINIMUM CHARGE \$2.00
Positions Wanted (full or part time individual salaried employment only), 1/2 the above rates payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices count as 10 words.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is \$8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured 1/8" vertically on one column, 3 columns—30 inches—to a page.

E.C.

New advertisements received by Jan. 24th appear in Feb. issue, subject to space limitations.

REPRESENTATIVES AVAILABLE

ATTENTION: MANUFACTURERS of electrical wiring material, control devices and equipment including aviation electrical equipment. Do you want a young live wire representative in the states of Louisiana and adjacent states? If so, address RA-325, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

MANUFACTURERS REPRESENTATIVE available to capably represent a reputable line in Chicago to an established clientele. Radio-appliances, lighting, equipment, accessories, etc. RA-329, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED

ANYTHING within reason that is wanted in the field served by Electrical Contracting can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

SALES ENGINEERS

WANTED

Experienced electrical men, familiar with low voltage distribution systems to act as sales specialists in important District Offices on following: Panel boards, safety switches, enclosed circuit breakers, bus duct and load centers. Men accepted to receive full training at factory at company's expense before assignment. Write to Supervisor, Technical Employment, 306 Fourth Avenue, Pittsburgh, Pennsylvania, for application form.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

PITTSBURGH 30, PA.

CHIEF ELECTRONIC ENGINEER

Company with seven years background in the field of designing and building automatic photo-electric equipment has Postwar plans that include a great opportunity for an individual who will be expected to handle developmental activity of electronic department. He will supervise electronic department personnel, coordinate activity of plant and field engineers, assume responsibility of entire department as executive head. Applicant should be thoroughly trained in practical as well as theoretical electronics, capable of supervising optical and electronic experimental activity. Should be capable of visualizing electronic coordination with mechanical equipment, able to assist design engineering in development of new units and supervise assembly, wiring, and eventual incorporation of units in completed machines; supervise installation of our machines in customers' plants.

P-328, Electrical Contracting

520 North Michigan Ave., Chicago 11, Ill.

FOR SALE

—complete electric motor repair equipment.

NECO MANUFACTURING CO.

Auburn, Indiana

UNIVERSAL TOOLS

Channel-lock pliers, coo-tee pliers, Crescent wrenches, vice grips, open and box wrenches, sockets, needle nose, side cutter diagonal pliers, screw extractors, screw drivers, wheel pullers. Remember: we have it, can get it, or it is not made. Prompt shipment order today. COD. Catalogue free.

DEALERS TOOL SUPPLY

Dept. EC 1527 Grand Av. Kansas City, Mo.

America's Best Assortment
**ELECTRIC MOTORS
GENERATORS
TRANSFORMERS**

from 1 H.P. to 1000 H.P. A.C.
25-50-60 cycle D.C., all voltages

ELECTRIC EQUIPMENT COMPANY

63 CURLEW ST. ROCHESTER, N. Y.
GLENWOOD 6783, P.O. BOX 51

"SEARCHLIGHT" Opportunity Advertising

—to help you get
what you want.

—to help you sell
what you no longer need.

Take advantage of it—For Every Business Want

"Think SEARCHLIGHT First"

Lighting Techniques

[FROM PAGE 47]

ing of outlets. However, to provide fairly uniform intensities over an entire area where general illumination is required, it is sometimes necessary to use intermediate size lamps.

Size and Shape: Lamp data booklets should be consulted for "light center length", overall lengths, and bulb diameter. General service lamps in wattages up to and including 150 watts are made in teardrop shape. Lamps of 200 watt size and larger are made in pear shape. In addition, 500, 750 and 1000 watt lamps are available in short tubular form, with a special bipost base socket.

Fluorescent Light Sources

Fluorescent lamps are diffuse line sources of light. Control of the light produced is therefore less accurate than is possible with a point source of light. Where diffuse illumination is required, however, the fluorescent lamp provides a very good source and offers many advantages. These lamps are made in two general broad classifications. The first classification which has been widely used is the low voltage high current type, generally referred to as the "hot cathode" type. The second classification, which has been less widely used, but is well suited to custom built lengths and special shapes for special and unique applications, is a high voltage low current type, and is generally referred to as the "cold cathode" type.

Fluorescent lamps for general illumination are now available in several diameters and lengths, varying from approximately one-half inch to more than two inches in diameter, and from eighteen inches to ten feet or more in length. Hot cathode type lamps are produced in standardized lengths, while cold cathode type lamps are produced in some standard lengths and are also available in custom lengths. Standardized lengths of long tubes with small diameters, and standardized circular lamps in three sizes have been announced by several lamp manufacturers as new tubes to become available.

Color Quality of Light Produced: Fluorescent lamps are produced with a variety of inside coatings of fluorescent chemicals. These materials reradiate visible light of varying color when activated with the ultraviolet radiation of the mercury vapor arc in these type lamps, depending on the chemicals, or phosphors, used. Standard colors normally available include the following: white, daylight, soft white,

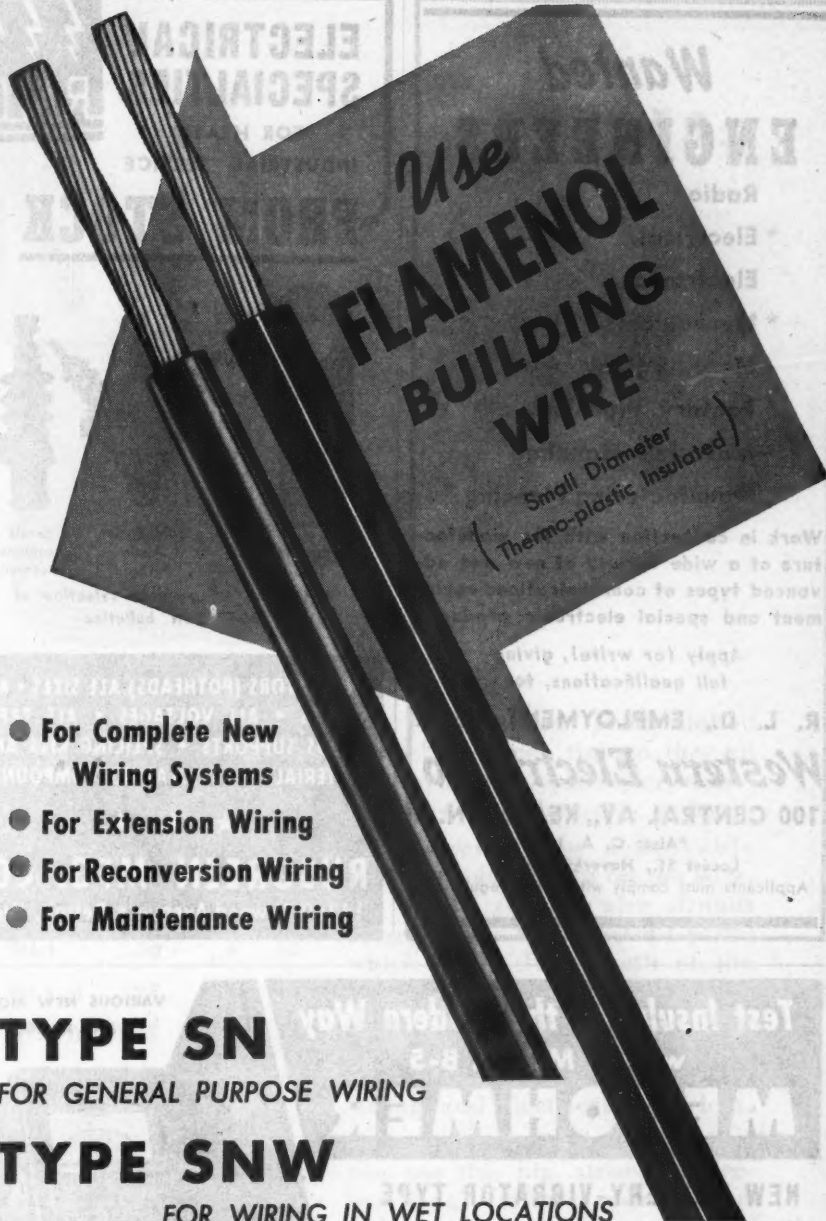
blue, green, pink, gold and red. (Under War Production Board restrictions, only white and daylight type lamps are in production at this time. The colored lamps listed were in production until wartime restrictions were imposed, and will again be produced when the restrictions are removed.) The white lamp produces a color of light approximating that of sunlight about one hour after sunrise, and technically, is designed for a color temperature of 3500 degrees Kelvin. Daylight lamps produce a color quality of light approximating the color of daylight with a uniform overcast sky. Stated technically, it has a color temperature of approximately 6500 degrees Kelvin. The soft white fluorescent lamp produces a pinkish white light, since it has a red producing phosphor added to compensate for the predominance of blue-green light characteristic in these lamps when designed to produce an approximate white light. The white, daylight, and soft white lamps are used for producing general illumination for visual seeing tasks. The colored lamps are used primarily for decorative purposes, and in achieving unusual and spectacular lighting results or for advertising.

Rated Operating Life of Lamps: Hot cathode fluorescent lamps are designed for 2500 to 3000 hours operating life. Cold cathode lamps are found to be lasting from 5000 to 10,000 hours of actual operating life. The lamps deteriorate through use by blackening and by becoming coated with dust and dirt. Therefore, exceptionally long lamp life is not necessarily desirable or economical.

Replacement Cost: Using the lumen-hour output of lamps at rated life and the list price of the lamps, 40 watt white lamps produce approximately 55,000 lumen hours for one cent. The 100 watt white lamp produces approximately 58,000 lumen hours for one cent. The replacement cost of the type of lamps used should be considered as part of the maintenance and operating cost of the lighting system.

Lamp Efficiency: The lamp lumens per watt, not taking into consideration the watts loss of auxiliary devices (ballasts or transformers), varies from about 30 for 15 watt daylight lamps to over 50 for 40 watt white lamps. The 40 watt lamp is more efficient in producing light than either lower or higher wattage lamps. The above data are applicable to hot cathode type lamps based on manufacturers' published data. For cold cathode type lamps, the lamp lumens per watt are dependent on wide choice of variables available to the de-

[Continued on page 174]



- For Complete New Wiring Systems
- For Extension Wiring
- For Reconversion Wiring
- For Maintenance Wiring

TYPE SN

FOR GENERAL PURPOSE WIRING

TYPE SNW

FOR WIRING IN WET LOCATIONS

You'll find Flamenol* Building Wire easy to use. It can be stripped and connected quickly. Its small diameter enables more conductors to be used in conduits or ducts. The hard smooth finish of its thermo-plastic insulation aids wire pulling. Moreover, Flamenol Building Wire can be installed in any location. Type SN is ideal for general purpose wiring wherever Type R is permitted. Type SNW is ideal for wiring in wet locations.

The insulation of this wire is practically ageless, has high dielectric and mechanical strength, is flame retarding and is resistant to oils, acids and alkalis. In addition, Type SNW Flamenol wire insulation has low moisture absorption. Both types of Flamenol Building Wire are available in sizes 14 to 2,000,000 CM.

Hear the General Electric radio programs: "The G-E All Girl Orchestra," Sunday 10 P.M. EWT, NBC. "The World Today" news, every weekday 6:45 P.M. EWT, CBS.

BUY WAR BONDS
AND KEEP THEM

FOR FURTHER INFORMATION see the nearest G-E Merchandise Distributor or write to Section W151-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

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• BUS SUPPORTS • SPlicing KITS AND
MATERIALS • INSULATING COMPOUNDS



RUSGREEN MFG. CO.

14260 Birwood Avenue • Detroit, Mich.



Lighting Techniques

[FROM PAGE 173]

signer, such as the tube diameter, tube length, current density in the tube, and voltage at which the lamps operate. The high voltage type long, slim lamps recently announced for availability in postwar will produce approximately 65 lumens of light per watt.

Size and Shape: Hot cathode type lamps for general illumination vary in wattage from 15 watts to 100 watts, and include 15, 20, 30, 40, 65 and 100 watt sizes. All lamps are tubular, and are 1 in., 1½ in. and 2½ in. in diameter. Lengths vary from 18 in. for the 15 watt lamp to five feet for the 100 watt lamp. Circular type lamps in three diameters will be available for postwar. Cold cathode type lamps vary in diameter from 12 millimeters to 25 millimeters. Lengths will probably be standardized at approximately six feet and eight feet. Cold cathode lamps lend themselves to custom made lengths, and can be curved for special custom jobs. No doubt much standardization of this product may be expected beyond that already accomplished.

It is estimated that about 95% of the hot cathode type fluorescent lamps used for commercial or industrial general lighting applications are the 40 watt and 100 watt sizes, due to the higher lumen output per watt for these sizes, and due to the economies offered in fixture costs, wiring costs, and other similar factors.

Mercury Vapor Light Sources

These light sources are used primarily in industrial lighting applications, where it is important to provide high levels of illumination, and desirable to use a minimum number of units. Common installations of mercury lighting include steel mills, rolling mills, foundries, machine shops, glass factories, textile mills, printing plants, and industrial plants having high ceilings. Use of mercury vapor light sources for general industrial plant lighting is limited to three size lamps: the 250 watt, 400 watt and 3000 watt. Of these, the 400 watt size is the most popular. The 3000 watt lamp is becoming more popular for use in large areas, however, and will probably be used more and more in industry in the future. The use of the 3000 watt lamp in combination with incandescent lamps in the lighting of the Budd Manufacturing Company plant at Bustleton, Pennsylvania, through a unique indirect lighting application was discussed in the Novem-

Test Insulation the Modern Way with a MODEL B-5 MEGOHMER

NEW BATTERY-VIBRATOR TYPE

No more tiresome cranking of a hand-driven generator . . . Entirely self-contained, steady test potential of 500 volts DC, available at the touch of a switch. Direct reading in insulation resistance.

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WRITE FOR BULLETIN No. 430-E

Operating Notes on

INDUSTRIAL ELECTRONICS

by Arthur G. Mohaupt, B. A., M. S.

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PRACTICAL ELECTRONIC TECHNICIAN**

A practical, useable ELECTRONIC MANUAL. A valuable aid to foremen, superintendents, engineers, electrical contractors, electricians—to everyone interested in Electronic Control devices. Packed with practical data on Thyratrons, Ignitrons, Electronic Lighting, Induction and Dielectric Heating; Photo Tubes, Photo Control devices, Relays and Timers, Resistance Welding Control, Electronic Motor Control, etc. Replete with charts, diagrams and timely data on the functions, installation, operation and maintenance of Electronic Control devices. **SEND FOR YOUR COPY TODAY!**

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A valuable digest of 12 lectures given to engineers and practical electronic technicians from over 50 leading manufacturing concerns. Many helpful charts and diagrams.

ber issue of *Electrical Contracting*.

Color Quality of Light Produced:

Mercury vapor lamps produce a characteristic blue-green light, which is particularly well adapted to the lighting of the neutral tones in a metal working plant. It is entirely lacking in the yellow-orange-red portion of the color spectrum. For this reason, it is often combined with incandescent lamps in about equal lumen output where it is necessary to have an approximately white light, giving the psychological effect of daylight.

Rated Operating Life of Lamps:

Mercury vapor lamps have a longer life when operated continuously than when used for intermittent service. In starting, five to ten minutes are required in order to reach normal light output. The 250 watt and 3000 watt lamps are rated by the manufacturers at over 2000 hours and the 400 watt lamp at over 3000 hours, under normal operating conditions. When these lamps are operated continuously for at least ten hours per start, tests show that the actual operating life increases considerably beyond the rated operating life.

Replacement Cost: The 250 watt lamp produces approximately 16,000 lumen hours of light for one cent based on normal rated life and list price for the lamp. The 400 watt lamp produces approximately 50,000 lumen hours and the 3000 watt lamp produces approximately 60,000 lumen hours for one cent on the same basis. The 400 watt and 3000 watt lamps offer operating economies comparable with incandescent or fluorescent lamps considering the replacement cost of the lamps only.

Lamp Efficiency: Not taking into consideration the watts loss of auxiliary devices (transformers), the 250 watt lamp produces approximately 28 lumens per watt, the 400 watt lamp produces approximately 40 lumens per watt, and the 3000 watt lamp produces approximately 40 lumens per watt. This efficiency is about double that of incandescent lamps and comparable with that of fluorescent lamps.

Size and Shape: The 250 watt lamp is a short tubular lamp, as is the 400 watt lamp. These two lamps are used with typical incandescent lighting fixtures having screw base type sockets. The 3000 watt lamp is a long tubular source, similar to fluorescent lamps, and requires a luminaire of a type similar to fluorescent sources.

The next article to appear in the February issue will take up basic designs of luminaires and their application.



**Sherman Type S-O
Solderless Lug**

Part No.	Max. Amp. Cap. N.E.C.	Range Wire Sizes	
		Max.	Min.
SO-8	35	8	14
SO-4	70	4	14
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SO-500	400	500M	250M
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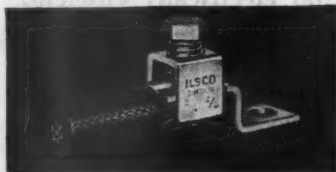


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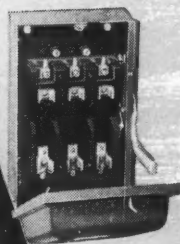
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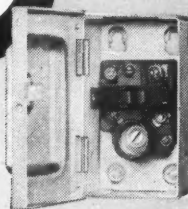
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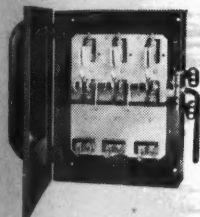
*Square D's Complete
Line of Safety Switches
means the right switch for
the job... every time!*



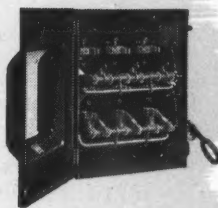
Type A Switches with concealed blades. Quick make, quick break and interlocked cover. Design permits smaller boxes with plenty of wiring space. Up to 200 amperes, 600 volts. H.P. rated. Made in 2 and 3 pole, 3 and 4-wire solid neutral.



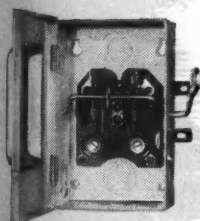
Blue Label Line—Type D Switches are compact, employing a rotary type of blade construction. Made for 2 pole and 2-wire and 3-wire, 230 volt A.C.-250 volt D.C. systems. Available for 30 to 60 ampere fusing. Front operated.



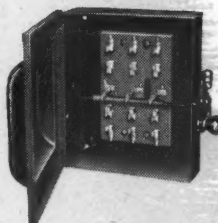
Type A Switches with visible blades. Quick make, quick break and interlocked cover; rated from 30 to 2400 amperes, up to 600 volts. Horsepower rated. Fusible and not fusible. 2, 3 and 4 poles and 3, 4 and 5-wire, solid neutral.



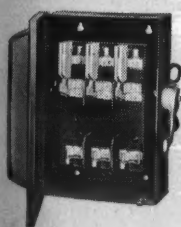
Manual Motor Starters are available up to 60 amperes, 575 volts A.C. horsepower rated. Auxiliary blades shunt running fuses when operating handle is moved to starting position. Releasing handle automatically moves blades to running position with fuses in circuit.



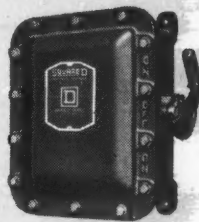
General Purpose Switches (Type D) are quick break only in capacities from 60 to 600 amperes inclusive. Thirty-ampere (and rain-tight) switches are not quick break. Made with 2, 3 and 4 pole and 2, 3, 4 and 5-wire s/n systems. 230 volt A.C. and 250 volt D.C.



Double Throw Switches. Made in sheet steel or explosion-resisting enclosures, approved for Class 1, Group D hazardous locations. Interlocked covers and quick make and quick break mechanism in sheet steel enclosures.



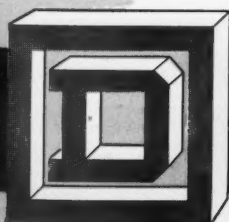
Type C Industrial Safety Switches are quick make and quick break. Made up to and including 600 amperes, 600 volt. Fusible and not fusible. Horsepower rated. 2, 3 and 4 poles, and 3, 4 and 5-wire solid neutral. Also available in rain-tight enclosures.



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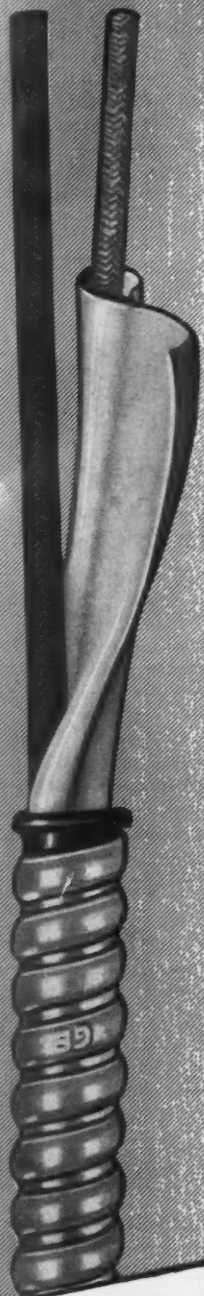


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FOR FURTHER INFORMATION on G-E BX or building wires or wiring devices see the nearest G-E Merchandise Distributor or write to Section CDW151-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

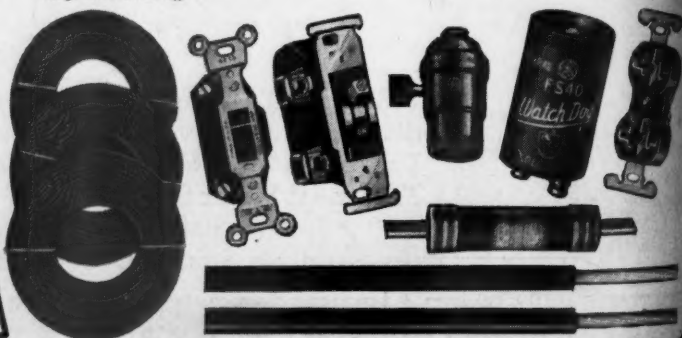
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Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 p.m. EWT, NBC. "The World Today" news every weekday 6:45 p.m. EWT, CBS.

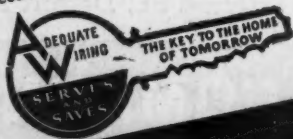
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General Electric also offers building wires and wiring devices for every wiring need including Type SN and Type SNW small diameter Flamenol* Building Wire and many different wiring devices—switches, lampholders, outlets, etc.

*Reg. U.S. Pat. Off.



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WILL PLAY A VITAL PART**
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play a vital part in making electrical con-
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